

ANNUAL REPORT

ON THE

AGRICULTURAL EXPERIMENTS AND
DEMONSTRATIONS

IN

ASSAM

FOR THE

YEAR ENDING THE 30TH JUNE 1917.



SHILLONG:

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Glossary.

Annual Report of the Jorhat Agricultural Experiment Station for the year ending the 30th June 1917.

This station is situated about 3 miles south of Jorhat, Sibsagar district, Assam Valley, and was established in the beginning of the year 1906. It was intended principally for sugarcane work. Since then, on account of peculiar soil conditions which altogether precluded the growth of most *rabi* crops even in the presence of abundance of soil moisture, the work has been extended to include a study of the factor causing this sterile condition with a view to its amelioration. This work has been going on since 1908, and we are now in a position to state that the sterile condition of the soil to most crops in the cold weather, and also to certain crops in the rains, is due to the accumulation of acid substances, amongst them being a specific toxin which has been isolated and experimented within culture solutions, with effects on the plant's root system and growth precisely similar to those observed in the field; these are readily neutralised and rendered harmless by dressings of lime or other base to the soil. An account of the experimental results leading up to this conclusion has been published as a memoir of the Department of Agriculture, Chemical Series, Volume III, No. 9, entitled "Studies of an acid soil in Assam."

In connection with the improvement of the soil by liming, the application of other fertilizers has been studied, and our regular scheme of manuring now includes green manuring and the application of the raw phosphates. Phosphoric acid has an effect second only to that of lime on these soils, but is preferably used in a basic form such as basic slag for instance, rather than in the form of acid superphosphate. While small initial applications of the latter act beneficially, its application in very large doses or its continued use over a number of years, in our own experience is clearly detrimental in the absence of periodic lime dressings on sour soils. If used in conjunction with lime, however, the case is quite a different one.

The original area of the station was about $35\frac{1}{2}$ acres, of which 1.7 acres is *hola* or ravine land and the remainder high land, which was under grass and scrub jungle at the time of acquisition. An additional area of about 24 acres has since been acquired, of which about 4 acres is *hola* land and the remainder high land. The total area at present is thus $59\frac{1}{2}$ acres. Most of the newly-added area has been put under cultivation and is being treated uniformly in blocks with a view to future experiments.

2. The soil of the high land is a reddish sandy loam of the old alluvium, lying on a hard greyish yellow sub-soil. Where the conditions have not been improved by cultivation, the soil is extremely shallow, varying from only 3 to 6 inches in depth.

The following report is by Mr. A. A. Meggitt, Agricultural Chemist, Assam :—

Report on analysis of Jorhat Farm soil.

	Surface soil.	Sub-soil.
	Laboratory No. 6.	Laboratory No. 5(a).
1	2	3
<i>Soluble in Hydrochloric acid with 12 hours' digestion at 100 C.</i>	Per cent.	Per cent.
Phosphoric acid ($P_2 O_5$)	0.025	0.020
Potash ($K_2 O$)	0.115	0.135
Lime (CaO)	0.154	0.144
Magnesia (MgO)	0.166	0.148
<i>Soluble in one per cent. citric acid with 7 days' digestion.</i>		
Phosphoric acid	0.008	0.008
Potash	0.007	0.011
Loss on ignition (organic matter and combined Water).	3.26	1.84
Nitrogen	0.115	0.051
Calcium carbonate	0.048	0.018
Reaction	Acid,	Acid.

Physical Constants.

	Hygroscopic capacity.	Maximum water saturation capacity.		Minimum water saturation capacity.		
		Per cent. of water in saturated soil by weight.	Per cent. of water in saturated soil by volume.	Per cent. of water by weight.	Per cent. of water by volume.	
1	2	3	4	5	6	7
surface soil ...	3.10	31.9	50.5	11.2	13.9	1.3
sub-soil ...	...	30.0	50.0	7.2	9.1	1.19

These analyses agree quite well generally with some others made some years ago by the Imperial Agricultural Chemist.

These samples are acid in reaction, and the total lime present in all combinations, as well as the carbonate of lime, is quite efficient in quantity.

Carbonate of lime has an enormous influence on a soil's welfare chemically, physically and bacteriologically.

Its effects on soil biological processes are in the right direction and very great; it also influences the texture of soils in a remarkable way, and is active in bringing into use the reserves of dormant plant food. Its presence in fair amount also ensures the most economical effect of any manuring given. Its absence forbids the use, for most cropping, of certain kinds of manures, unless liming be first resorted to.

Any upland soil containing such small amounts of total lime and lime carbonate as are here present will most certainly respond markedly in the case of most cropping to applications of lime.

The amount of organic matter is probably greater than obtains in many Indian soils, but there is no doubt that a light soil of this character will be much improved in many ways by an increase in the amount of humus.

A good deal of the organic matter present is of a doubtful character and consists very probably of very old residues of little value; it is the presence and active decay of comparatively recent additions of organic matter which puts life into a soil.

The percentage of nitrogen present in the surface soil is what would normally be considered a fair one but in view of the absence in anything like adequate quantity of carbonate of lime, conditions for nitrification and soil bio-chemical processes generally are probably not as favourable as they might be by a long way, and an increase in the amount of nitrogen is indicated as desirable.

Of potash there is no dearth, and there would seem to be no immediate need for potash manuring.

Regarding phosphoric acid, these samples show a deficiency both in "total" as well as "available" supplies. There is thus a "real" as opposed to a mere temporary lack in respect of this element of plant food.

This lack of phosphoric acid is further aggravated by the absence of sufficiently large amounts of lime carbonate and humus, high percentages of which may, and often do, offset a smaller percentage of phosphoric acid.

An acid condition of soil, besides being harmful in itself, very often brings about a more rapid depletion of the soil's stock of phosphoric acid, in consequence of which most soils of a decidedly acid character are found to be lacking in this element and to respond to its suitable application.

Turning to the physical constants, the hygroscopic capacity is low, and about what one would expect for this class of soil. It means that only water which is in excess about 3 per cent. is available for crops, and plants are able to reduce the soil moisture content to somewhere about this figure before they begin to wilt. The top 6 inches of soil even during the cold weather normals contains a good deal more moisture than 3 per cent. when under a close standing crop, so that usually there is sufficient water for the crop's requirements.

As regards maximum saturation capacity, these soils agree quite well with quoted figures for similar soils in Europe, and suggest that the optimum proportion of water for the growth of the plant is about 13 to 16 per cent. A recent determination of soil moisture in the surface 6 inches of the soil of this farm in August, some few hours after rain, gave 17 per cent. water. Soil moisture conditions are therefore probably extremely favourable for growth during the rainy season in normal seasons.

The figures for minimum saturation capacity are much lower than those cited (Hall, *The soil*, page 69) for similar soils in Europe, and this is probably due to the lower content of humus which obtains in our soils. This is an extremely important figure in gauging a soil's power to retain a reserve of moisture for crops during dry periods.

The sub-soil is worse in this respect than the surface layer, suggesting that the incorporation of organic matter, if it can be buried sufficiently deep, will have a great ameliorating effect.

The sub-soil is capable of very great improvement indeed as the figures show, but it would probably be immediately disastrous to work it so deeply as to bring any considerable amount to the surface at once.

The growth of deep-rooting legumes as green crops will assist materially, but if the sub-soil could be stirred occasionally, while at the same time the surface cultivation is gradually deepened so that green crops may be more deeply buried, a greater depth of surface soil will result, which on this farm is very much to be desired.

I am convinced that for cane cultivation, until the surface soil has been deepened and the amount of humus increased, it is of little use attempting manurial experiments on cane with artificial manures. No amount or combination of the latter can ever make up the case of a crop like sugarcane for loss of fertility due to shallow cultivation and lack of "humus".

3. The farm is equipped with a godown, combined office and rest-house, quarters for Farm Manager, clerk and apprentices, cattle shed, Dutch barn, and is enclosed by "Ideal" wire fencing. A Hornsby oil engine and crushing mill was installed in 1911 for dealing with the cane.

Buildings and machinery.

4. The rainfall recorded during the growing period of the crops referred to is given with the normal rainfall below :—

Month.				Actual rainfall, in inches.	Normal rainfall, in inches.
1				2	3
1916,	April	...	...	8.14	8.54
"	May	...	...	7.87	9.26
"	June	...	...	7.88	11.36
"	July	...	...	12.29	14.76
"	August	...	...	14.78	15.15
"	September	...	...	10.95	9.18
"	October	...	...	6.63	4.07

Month.	Actual rainfall, in inches.	Normal rainfall, in inches.
1	2	3
1916, November	0.75	0.69
" December	0.21	0.52
1917, January	0.77	0.93
" February	5.76	1.32
" March	1.85	3.90
Total ,	77.38	79.68

Rainfall was nearly normal and nicely distributed and the crops were generally sown under good conditions. The Christmas rains however failed us, and the *rabi* crops suffered in consequence to some extent. The cold weather was rather more severe than usual and this combined with heavy and continuous fogs retarded the ripening of the cane.

Experimental work. 5. Paragraph 5. The work of previous years was continued, and extended as follows :—

- I. Sugarcane experiments.
- II. Soil investigations, and manurial tests.
- III. Trials of new crops, or new varieties.
- IV. Paddy selection.

6. The work includes the testing of varieties, manurial experiments, trials of different planting methods, and distribution of the best varieties. Over 1,07,000 cuttings were sent out during the cold weather.

No analysis was possible this year on account of the work at the Kamrup farm.

Sugarcane varieties. Ratoon Cane.

7. The following varieties planted in

Block B in 1915 were ratooned :—

I. Phosphate area. Duplicate $\frac{1}{10}$ th acre plots of B147, B376, and Striped Mauritius.

II. Non-phosphated area. Duplicate $\frac{1}{10}$ th acre plots of B147, B376, and Striped Mauritius.

In addition 1st acre plots of B208, *Gandari*, *Magh*, *Magh* sport, *Kheri* and Red *Tanna* were ratooned.

The results of the plant cane crop appeared in paragraph 8 of the last year's report.

The usual cultivation was given to the ratoon crop, the common manuring being 2,400 lbs. rape cake per acre given in three dressings. Harvesting took place from the middle of January 1917 to the middle of February. The results appear in Table I.

TABLE I.
RATOON CANE, 1916-17—BLOCK B.—(VARIETIES.)
(Figures are "per acre.")

Plot.	Variety.	Plots.	Cane.	Juice.	Juice on cane.	Ger.	Remarks.
1	2	3	4	5	6	7	8
1 } 1a } 4 } 4a } 9 } 2a } 5 } 3 } 3a } 6 } 6a }	B 376 Striped Mauritius	1/2th 1/2th 1/2th 1/2th 1/2th 1/2th 1/2th 1/2th 1/2th 1/2th 1/2th	50,060 50,880 51,400 51,920 45,750 57,500 55,960 60,470 61,500 59,980 63,360 19,880 45,940 52,530 46,450 57,440 63,960	33,010 30,800 34,850 33,570 23,700 35,690 33,810 34,700 38,530 40,18 0 39,840 33,060 11,560 26,530 34,104 28,980 40,250 32,030	65.9 61.3 67.4 64.8 63.9 61.3 67.6 63.1 63.7 68.9 69.4 62.5 59.7 55.6 65.3 62.4 70.0 60.1	4,205 4,553 4,903 4,105 4,443 5,322 5,860 4,966 5,560 5,714 5,883 5,609 1,371 3,703 5,554 4,377 4,433 3,800	The (a) plots were on the phosphate area.

Magh ...
Majh sport ...
B 208 ...
Tomas ...
Gendari ...
Kleri ...

The ratoon crop is a considerable improvement on last year, the season being much more favourable. Striped Mauritius did best followed by B 208, B 147 and B 376. The local variety Magh as usual ratooned badly. A sport of this variety discovered some few years ago gave however more than twice the yield of cane and three times the amount of *gur* that its parent did.

The average increase of cane per acre due to application of phosphate was only some 2,500 lbs., a much smaller increase than was obtained in the ratoons on Block E last year. The area on this Block (B) to which the phosphate was applied however was much the worst part of the Block, and it is very satisfactory that any increase at all was obtained.

8. In preparation for cane and following the usual rotation this block was green-manured with Cowpea in 1915, half the block being given a dressing of 5 cwts. Stane's Flour Phosphate per acre before sowing this crop. Rape was sown as a catch crop early in October 1915, and ploughed in while in flower in the middle of November. As usual both these crops made much heavier growth on the phosphated area. Sugarcane was planted in February 1916 direct into the plots on nice moisture.

The following varieties were tested against each other, B 147, B 376, striped Mauritius, Kheri, Magh, Magh Sport, and two new promising varieties Barbadoes A and B 6450, plots of 1/10th acre of each variety being provided on both phosphated and non-phosphated areas. Common manuring was 500 maunds cowdung per acre, half at planting and the remainder in two equal dressings at either earthing; in addition certain plots received rape cake 15 maunds per acre as indicated on the following table. Harvesting took place in February and March 1917. The results appear 18 in Table II.

TABLE II.
PLANT CANE VARIETIES.—BLOCK A.
(*Figures are per acre.*)

Plot.	Variety.	Manuring.	Cane.	Juice.	Juice on cane.	Ger.	Remarks.
1	2	3	4	5	6	7	8
1 1(a)	B 147 ...	Per acre. Cowdung.	Lbs. 54,080	Lbs. 24,220	Per cent. 64.4	Lbs. 6,604	(a) The plots were on the phospho- red area.
2 2(a)	Striped Mauritius	40,000 lbs.=100 lbs. nitrogen.	64,610	43,640	66.0	7,544	
3 3(a)	B 378	Cowdung.	71,340	40,800	69.8	8,610	
4 4(a)	B 147	Cowdung.	82,250	53,930	66.0	8,970	
5 5(a)	Striped Mauritius	40,000 lbs.=100 lbs. nitrogen.	62,320	43,120	69.1	6,786	
6 6(a)	B 378	Cowdung.	67,060	45,860	67.5	7,268	
7 7(a)	B 147	Cowdung.	61,980	40,600	61.6	8,308	
8 8(a)	Striped Mauritius	40,000 lbs.=100 lbs. nitrogen.	75,340	59,170	69.0	8,763	
9 9(a)	B 378	Cowdung.	73,370	41,320	73.1	6,424	
10 10(a)	B 378	Cowdung.	73,680	41,320	73.1	6,424	
11 11(a)	B 378	Cowdung.	86,480	44,790	68.1	7,660	

7	Barbados A	...	...	60,350	54,420	67.7	7,570
7(a)		...	...	88,180	60,220	66.3	6,456
8	B 6450	...	...	57,930	39,420	68.0	7,780
8(a)		...	...	60,140	41,460	68.9	7,841
9	Magh Sport	...	...	60,470	40,400	65.8	...
9(a)		...	...	67,490	44,670	66.3	...
10	Magh	...	...	58,140	36,650	62.9	...
10(a)		...	...	48,430	33,880	69.6	...
11	Kheri	...	...	79,875	48,100	54.1	6,726
11(a)		...	...	78,300	46,975	60.0	6,714

Cowdung 40,000 lbs. ...

As the figures show the crop was a very good one, the average yield per acre for the whole of the varieties being 30 tons, while a new variety Barbadoes A gave 39.4 ton per acre on the phosphated area. Both new varieties Barbadoes A and B6450 gave a very good account of themselves, and promise well. Barbadoes A is a medium thick cane of erect habit, hard and tillets well, is clean and has no signs of disease, and has prominent buds.

B6450 is thicker, and also erect, medium hard, tillers fairly well, is clean and has no signs of disease, and has medium buds.

The other exotic varieties all did very well with striped Mauritius best. The sport of the local variety *Mayh* again easily beat its parent.

The phosphated plots in almost every case gave a considerable increase over the non-phosphated but otherwise similarly manured plots, the average increase for the whole area being almost exactly 3 tons stripped cane per acre. Valuing the cane at five annas per maund (80 lbs.), this gives a profit on the first cane crop of Rs. 10 per acre. The ratoon cane and the other crops in the rotation should increase this profit considerably.

As shown in Table II, 6 plots received 150lbs. nitrogen per acre as cowdung and rape cake, while 6 other plots were given only 100lbs. nitrogen as cowdung. The average increase per acre due to the rape cake is some 2,850lbs stripped cane, valued at Rs. 11. The cake costs Rs. 30 per acre. With our rotation, including a green-crop and a catch crop of rape in the year previous to cane, it evidently does not pay to use cake in addition to the cowdung used.

9. Commenced in Block B in 1915; the plant cane results appear in paragraph 10 of last year's report. Sugarcane planting experiment. Ratoon. Cane rows were 4 and 5 feet apart respectively, and different methods of planting were adopted, providing in the former case from 5,600 to 18,200 sets, and in the latter 4,600 to 15,000 sets per acre. B147 was the variety used. Manuring was 2,400 lbs. rape cake per acre. The results appear in Table III.

TABLE III.
BLOCK B.—RATOON CANE, 1916-1917.
Planting Experiment.

Plot.	Method of planting.	Plot area.	Number of rows.	Width apart of rows.	Number of sets per acre.	Weight cane per acre.	Weight cane per row.	Remarks.
1	2	3	4	5	6	7	8	9
1	Ordinary method	Acres. $\frac{1}{16}$ th	5	4	5,330	Lbs. 64,750	Lbs. 1,295	The ordinary method of planting consists in disposing the sets 2 ft. apart and to center in the rows.
2	Sets end to end	$\frac{1}{16}$ th	5	4	10,230	68,300	1,367	
3	Double row ordinary	$\frac{1}{16}$ th	5	4	10,000	65,300	1,306	
4	Double row end to end	$\frac{1}{16}$ th	5	4	18,200	64,350	1,128	
5	Ordinary method	$\frac{1}{16}$ th	4	5	4,000	66,800	1,420	
6	Sets end to end	$\frac{1}{16}$ th	4	5	8,250	55,350	1,389	
7	Double row ordinary	$\frac{1}{16}$ th	4	5	8,600	45,620	1,143	
8	Double row end to end	$\frac{1}{16}$ th	4	5	15,000	57,000	1,440	

Though wider planting has given a bigger weight of cane per row, the narrower planting has this year given much bigger ratoon crops per acre. Combining these figures with those for the plant cane last year, we arrive at the following total yields of cane for the two successive crops:—

Plot.					Lbs.
1	...	...	...	...	115,080
2	...	...	...	...	118,180
3	...	...	...	...	124,950
4	...	...	...	...	116,440
5	...	...	...	...	98,000
6	...	...	...	...	102,090
7	...	...	...	...	99,640
8	...	...	...	...	101,880

The figures bear out previous years' results in that the narrower planting gives the bigger crops, while not more than 8,000—1,000 sets per acre cane be economically used.

10. Two of the new varieties received from Barbadoes in 1914. New varieties of Barbadoes A and B6450, were given field plots this year, and did very well, one of them giving nearly 40 tons stripped cane per acre, *vide* paragraph 8.

Six more received 1915 from the Government sugarcane Expert Coimbatore were multiplied in the nursery, B 3412 and J 33 A did well, while J 247 was only medium. These three varieties have been given field plots this year 1917.

Java Hebbal, B 1529 and Red Sport of Striped Mauritius were very poor and are being taken on another year in the nursery.

Three new varieties have been received this year, *viz.*, Red sport of Striped Mauritius *ex*-Kamrup Farm, Ashy Mauritius and Kala Bombai.

11. The various experiments bearing on Soil investigation. this work were continued; they are as follows:—

Block G : Liming experiment, commenced 1909.

„ C: Liming and manurial experiment; also a wood ashes experiment, commenced 1911.

Block K: Experiments to ascertain the reasons for the pronounced effect of lime on the farm soil, commenced 1912.

Block L: Ground lime-stone experiment, started in 1913.

Blocks E, B, A, and D: Experiments in the use of raw mineral phosphate, initiated 1913, 1914, 1915 and 1916, respectively.

For previous details the reports for 1912—1916 may be seen.

12. Half this block was limed 8 years ago, and both sides are regularly and similarly cropped with a view to determine how long the effect of the single lime dressing will last. The cropping this year was cowpeas for green-manure in the rains, and the usual crops *matikala*, oats, gram and rape in the cold weather.

Cowpeas as usual did well on the limed and poorly on the unlimed area.

In the cold weather all the crops died out soon after germination on the unlimed side. On the limed side fair crops of oats and *matikala* were harvested; gram and rape made fair vegetative growth but matured no grain. Thus the lime effect is still quite marked though 8 years have elapsed since the lime was applied.

Block C. Liming and
Annual Experiment.

13. Commenced in 1911 this experiment was continued in its 6th year.

Those plots which had 10 maunds (=800lbs.) lime per acre annually from 1911—15 were given a sixth dressing of 10 maunds per acre in 1916, the annual cross dressing of bonemeal and cowdung being applied to their respective plots as usual.

All the limed plots have now had 60 maunds (4,800lbs.) slack lime per acre, applied variously as one initial dressing, or two triennial dressings of 2,400 lbs. each, or six annual ones of 800lbs.

The cropping for 1916-17 was *jowar* in the rains and gram in the cold weather. The *jowar* was sown in drills whereby it was found possible to keep the plots clean by inter-cultivation, thus eliminating weed competition.

Observations during
growth.

Jowar germinated well, but all the plots were more or less attacked by crickets, some of the plots becoming patchy in consequence, more particularly on the green-manured block. The crop throughout was darker green and stronger looking on the green-manured area.

All the limed plots grew strongly throughout; the non-limed plots made a distinct struggle for existence, particularly those annually cross-dressed with both cowdung and bonemeal, but the crops were practically negligible. The various cross-dressings showed up well as the plots were kept thoroughly cultivated and clean, and thus the competition by weeds, which spoilt the *jowar* results of two years ago,* was eliminated. Bonemeal had a well marked beneficial effect, but after lime this crop always responds most to cowdung. Of the limed plots those which had the

* Vide report of the Jorhat experiment station for 1915, paragraph 13.

smaller lime dressings annually or triennially (see Table IV, plots 2, 3 and 6, 7) were throughout the growing period much in advance of the plots which had the single large initial dressing.

The crop was cut green for fodder in September.

Gram was sown in October. It did well at first on the limed sections; the dry season however went against it. It flowered late and the heavy rains in February rotted the seeds in their pods. Threshing was impossible, thus no records are available.

The records for the *jowar* crops appear in Table IV.

TABLE IV.
BLOCK C.—JOWAR.—Sixth year of Experiment.
(Figures are per acre.)

Cross-dressings.	Non green-manured block.					Green-manured block.					Remarks.
	No lime, Plot 1.	Lime total 4,800 lbs. (800 lbs. annually for 6 years), Plot 2.	Lime 4,800 lbs. (2,400 lbs. tri-annually), Plot 3.	Lime 4,800 lbs. initially, Plot 4.	No lime, Plot 5.	Lime total 4,800 lbs. (800 lbs. annually for 6 years), Plot 6.	Lime total 4,800 lbs. (2,400 lbs. tri-annually), Plot 7.	Lime total 4,800 lbs. initially, Plot 8.			
1	2	3	4	5	6	7	8	9	10		
A. XU	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.			
B. Bonemeal 240 lbs. per acre annually 1st-6th years.	Nil	10,960	9,090	7,890	Nil	10,300	9,420	7,230			
C. Bonemeal 240 lbs. plus cowdung 8,000 lbs. per acre annually in 1st-6th years.	50	13,640	14,640	11,440	100	12,940	11,560	6,800			
D. Cowdung 8,000 lbs. annual- ly per acre in 1st-6th years.	1,630	17,090	16,680	14,860	1,220	18,440	19,700	1,11,000			
	290	18,440	14,760	15,340	880	18,780	19,230	13,510			

In regard to the differential lime applications the evidence of the *jowar* crop, is in this the sixth year of the experiment, in favour of the smaller and more frequent dressings, *cf.* plots 2, 3, and 4, the relative crops being respectively as 125 : 114 : 100, and plots 6, 7 and 8 the relation being as 158 : 157 : 100. This bears out last year's evidence that the apparent superiority of the heavy initial dressings is giving way in favour of the smaller recurring ones as time goes on.

Lime dressings. It is curious that though bonemeal when used alone has given a distinct increase over the check plots (*cf.* section B with corresponding plots of section A), when used in addition to cowdung it does not on the average increase the yield (*cf.* sections C and D), the aggregate yield for these two sections being almost identical. Given a good dressing of lime and cowdung, the use of bonemeal for *jowar* would not appear to be economical.

Cross-dressing. The aggregate yield for the green-manured area is very slightly less than for the ungreen-manured area, the crops being in the proportion of 100 : 104. This may be explained by the facts (1) that the green-manured area carried a very much heavier crop of oats in the preceding cold weather, (2) crickets did much more damage to the *jowar* here than on the ungreen-manured area.

The value of organic matter is emphasized by the following analysis of the table :—

Relative yield of <i>Jowar</i> .		
	Cowdung plots.	Non-cowdung plots
For whole area ...	... 161	100
Non-green-manured block separately.	147	100
Green-manured block separately	178	100

14. This experiment was commenced in 1911.

Wood ashes experiment. Five plots receive respectively 5, 10, *nil*, 15 and 20 maunds (1 maund=80 lbs.) wood ashes per acre per annum. Half of each plot is cross-dressed with cowdung 100 maunds per acre per annum.

Cropping in this, the sixth year, was *jowar* followed by *Kulthi-kalai*. The latter crop, a new crop to the farm, was apparently sown too late, for though it made good vegetative growth it failed to ripen its seeds before the February rain ruined it.

The *jowar* was cut green for fodder in August ; the yield were as follows :—

				Green-Jowar.
Plot 1	{ 5 maunds ashes per acre ...			Nil.
	{ 5 " <i>plus</i> cowdung			1,211 lbs.
Plot 2	{ 10 " <i>plus</i> cowdung			392 "
	{ 10 " <i>plus</i> cowdung			3,689 "
Plot 3	{ Nil 			Nil.
	{ cowdung 			Nil.
Plot 4	{ 15 maunds ashes per acre ...			2,079 lbs.
	{ 15 " <i>plus</i> cowdung			8,456 "
Plot 5	{ 20 " <i>plus</i> cowdung			5,243 "
	{ 20 " <i>plus</i> cowdung			11,284 "

The crop yields increased largely with every increase in the amount of ashes used, and the 15 and 20 maunds ashes plots now produce fair crops of *jowar*, especially where used along with cowdung. The improvement in these plots is enormous ; four years ago *jowar* was tried and died out very early over the whole area. This experiment should serve as an incentive to cultivators to preserve their ashes along with their cowdung.

15. Commenced 1913 on very poor and infertile newly broken up land. The scheme consists of 6 plots of 1-3rd acre each in two series, of 3 plots each. One series Section A, is cultivated shallow with country implements, the other Section B being worked deeper with English ploughs. Ground limestone was applied as follows in 1913 :—

Sections A and B	{ Plot 1		... 15 maunds lime-stone per acre.
	{ " 2		... Nil.
	{ " 3		... 30 maunds lime-stone per acre.

For further details of the scheme see previous years' reports.

The cropping this year was cowpeas for green-manure in the rains, followed by wheat in the cold weather. Cowpeas did well all over, being best however on the limed plots ; the crop was hoed in during July. Wheat germinated well all over, but died out very early on the unlimed plots.

The wheat led all the way through on the shallow cultivated Section A, otherwise improving with increase in the lime-stone application on either section. It tillered very badly indeed and

uffered much from the failure of the usual December rains. Nowhere did the wheat make even a fair crop; this is not a wheat soil. Knowing this however the crop was purposely grown as being a deep rooter, and to confirm the results obtained in the previous year. The yields of grain were as follows :—

	Plot 1.	Plot 2.	Plot 3.
Section A (shallow cultivation)	7lbs.	nil	168lbs.
Section B (deep cultivation)	5 „	„	61 „

The results agree well with those obtained last year for wheat, and the indications are similar to those given by oats, which is a much shallower rooter. For these two crops wheat and oats, at any rate, using only moderate lime dressings, it will pay to keep the lime near the surface. Both crops appear to be very susceptible to soil acidity in the seedling stage, and this factor, within the limits of the experiment, appears to be a more potent one than that of depth of rooting, in deciding to what depth a given application of lime-stone shall be incorporated with the soil by cultivation.

Block K. Experiment to ascertain the early functions of lime.

16. This experiment commenced in 1912 was continued in its fifth year. The results obtained during the year with oats and *jowar* go to confirm and strengthen those of previous years. Reference may be made to the Jorhat farm reports for 1913 *et sequa* and also to a Memoir entitled "Studies of an acid soil in Assam" published as No. 9, Volume III, Chemical Series of the Memoirs of the Department of Agriculture in India.

The *jowar* crop, now grown for the first time on these plots, specially emphasized the need of lime or some other acidity neutraliser, also indicating the importance of phosphatic manuring; further it became very marked that it is only after the soil's requirements for lime and phosphate have been met, that one can expect a response in crop production to additions of artificial manures such as sulphate or muriate of potash, nitrates of soda potash or lime, sulphate of ammonia, etc.

The toxicity of those plots which annually get a dressing of sulphate of ammonia in the absence of lime becomes more marked year by year.

With large of time this experiment is furnishing evidence in regard to those manures which tend to liberate available potash from the potash reserves in this soil. From the outset certain weeds established themselves very strongly on those plots which received direct additions of potash manures. These same weeds are now gradually year by year becoming more prominent

on other plots which get no potash at all; these are the carbonate, sulphate, and nitrate of lime plots, and it appears to be the fact that of the various manures used, these are most potent in liberating available potash.

17. *Blocks E, B, A and D.*—Flour phosphate experiments in the Sugarcane Rotation.

About 1 acre of each of the four blocks which regularly come under cane two years out of four, has been dressed with flour phosphate with a view to observing its effect on the various crops in the rotation.

The phosphate is applied in the fourth year of the rotation previous to sowing the green-crop of cowpeas. The present rotation is as follows :—

1st Year	...	...	Plant cane.
2nd "	...	...	Ratoon cane.
3rd "	...	...	{ Rains—Green-crop of <i>dhaincha</i> . Rabi—Oats.
4th "	...	...
			{ Rains—Green-crop of cowpeas. Rabi—Catch crop of rape ploughed in mid November.

As there are four blocks in the cane rotation, and this experiment was only commenced in 1913, much information is naturally not yet available.

The rotation has been completed on Block E only, so far; in the year of application the phosphated area, made a much better cowpea crop, and gave an increased yield of 210 lbs. per acre of rape seed valued at Rs. 11-10; during the first and second years of the rotation, the average increase per acre for the two crops of cane was 9,200 lbs. valued at Rs. 36; in the third year the *dhaincha* made a much better crop on the phosphate area, while this area gave an increase of 200 lbs. oats per acre in the following cold weather, valued at Rs. 7-8. The total value of the increase is Rs. 55-2 at a cost for phosphate of Rs. 15-12, leaving a net profit of Rs. 39-6 per acre.

The other blocks in the rotation are giving similar results. The effect of the phosphate on the plant and ratoon cane crops of the year under report is discussed in paragraphs 7 and 8 of this report.

Block D was the area to receive the phosphate this year, one acre being thus treated. The following crop of cowpeas made particularly fine growth on the phosphate area, though also

good on the untreated area. Rape was grown as a catch crop and ploughed in mid November while in flower, making a 16-anna crop on the phosphated area and an 8-anna crop on the other.

18. This block was under Java Natal indigo, one acre being sown on limed and one acre on unlimed land. Extension area. Sown in May, harvesting took place from Block M. December to March. The crop did very well on the limed area and set a fine crop of seed, which was however ruined by a heavy hail storm just previous to ripening, with the result that only about one-third of the seed was recovered, viz., 254 lbs.

The crop on the unlimed land died off while young.

Sugarcane for distribution.—The whole of this cane was used for distribution, some 107,000 sets of Blocks O and R. the three varieties, B 376 Striped Mauritius and B 147 being sent out from the farm this year.

19. These blocks were green-manured with *dhaincha* following ratoon cane. The crop did well everywhere, especially on the area phosphated in 1913 where the *dhaincha* was ready for ploughing in fully a fortnight before that on the surrounding unphosphated land. Other crops. Blocks E and F.

Oats was taken as the cold weather crop, and also did quite well, the average outturn being 960 lbs. grain per acre. The phosphated area gave an increase of 200 lbs. grain per acre over the untreated area, and ripened off earlier.

Cowpeas for seed were sown here, selected seed from the previous year of quick-growing heavy-cropping varieties being used. The seed was Block H. sown mid-August in rows 2 feet apart, seed rate 10 lbs. per acre, and the plants were subsequently thinned out 2 feet apart in the rows. The crop was harvested from November to January and yielded 800 lbs. excellent seed per acre.

A variety of crops was grown here for observation, comparison and selection, e.g., cowpeas (varieties); soy Kitchen garden. beans (varieties); Java Natal indigo; ground nuts (varieties); sunn hemp and *dhaincha* for seed; lucerne and beerseem.

Five varieties were grown, the one named "Jorhat Brown" again being the best. This variety grows Cowpeas. extremely rapidly, making a very bulky and succulent green-crop with 6 weeks growth, and not forming vines so early as most other varieties. It also seeds very freely if sown about the middle of August.

Soy beans. Shillong soy beans gave 2,160 lbs. seed per acre as against 1,980 lbs. for the farm variety.

Ground nuts. Four varieties were grown on plots of 768 sq. ft. area; yields as follows :—

Virginia ...	...	...	1,700 lbs. per acre.
Big Japan ...	...	...	1,590 „ „ „
Raipur ...	...	...	1,360 „ „ „
Farm seed ...	...	...	1,250 „ „ „

This crop, a most excellent fodder, has been tried for the past 2 years. It requires well drained good loamy soil, and the land must be absolutely clean, *i.e.*, free from weeds if the crop is to persist. Lime should be liberally applied some time before sowing and deeply worked in, if the soil is sour or deficient in lime. A dressing of 3 cwt. basic slag per acre, or failing that of finely ground bone-meal, will materially help the crop; well rotted cowdung if available should also be freely used. Where this crop has not been previously grown, a dressing of soil from an old lucerne patch at the rate of 100 lbs. per acre, if applied previous to sowing and light-hoed in immediately after spreading, may give excellent results, as it did with us. Soil for this purpose can be supplied by the Farm Manager on application. The crop suffers from hot sun in its early stages, and should not be sown too early. As the seasons vary considerably, nothing but making experimental sowing at different times say from the middle of November onwards till January can decide the best time for sowing. In our experience sowings made towards the end of December immediately after the Christmas rains, when these do not fail, give very good results. This year the December rain failed us, and the crop was not sown till after rain about the end of January, and did not do so well. Where irrigation is available sowings made throughout December should do well.

On weedy land, or where irrigation can be practised, the crop is better sown in lines 18 inches to 2 feet apart; this permits of inter-cultivation and weeding. Otherwise it does well sown broadcast at the rate of 15 to 25 lbs. seed per acre, according to the nature of the soil. Excellent seed can be obtained from Pestonjee Pocha & Sons, Poona.

Three cuttings of fodder should easily be obtained, and if drainage is very good, the crop may even extend over the rains into a second season: otherwise it must be re-sown every year. In our case, three cuttings were possible, the first giving at the rate of 6,400 lbs. green fodder per acre, or nearly three tons.

The 2nd and 3rd cuts were slightly lighter, but were unfortunately not weighed. Weeds, which are a veritable curse to lucerne, gradually wore down the crop; after the third cutting it was therefore grazed off and hoed up.

This crop was tried in the cold weather both on high land, and also in a paddy *hola* after the water had subsided. In both cases it failed miserably as irrigation was impossible on the high land, whereas in the *hola* conditions were apparently too wet.

20. Fruit trees comprise 16 lichis, 6 mangoes, one custard apple, 3 sepota, 5 guavas, 1 pomelo, 1 plum and 3 papaya besides several varieties of plaintain. Orchard. Most of the trees fruited well except the mangoes.

21. The receipts from sale-proceeds amounted to Rs. 3,578-0-9 or nearly Rs. 1,000 more than last year. The Receipts and expenditure. total expenditure including cost of establishment and charges on capital account amounted to Rs. 11,642-6-5.

22. This consists of a Manager on Rs. 100—10—200; clerk on Rs. 25—1-8—40 and a peon on Rs. 8. The Establishment. number of apprentices on the farm during the year was nine, one of whom Sheikh Karim Box proceeded to the Agricultural College, Sabour, in June. Two completed their training—*Chandi Charan Dutta* and *Biswanath Dutta* and were appointed temporary Demonstrators from 1st November 1916.

The following new apprentices joined, Krishna Chandra Gogoi, Kantiram Gogoi, Lakshi Nath Barua, and Nirmal Chandra Kakati, the two latter being Nowgong men.

Srijut Binaram Das held the post of Manager throughout the year.

23. The Director of Land Records and Agriculture, Assam, inspected the farm three times. The Acting Inspection. Deputy Director of Agriculture, Assam Valley, being in residence at Jorhat was in constant touch with the farm throughout.

JORHAT :
The 30th July 1917.

A. A. MEGGITT,
Acting Deputy Director of Agriculture, Assam Valley.

ANNUAL REPORT OF THE UPPER SHILLONG AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1917.

History and description. The Upper Shillong Agricultural Station was established in 1897-98. It is situated on the Cherrapunjee road, $5\frac{1}{2}$ miles from the town of Shillong, and occupies the site of the old Model Farm which ceased to exist in 1879. The elevation of the place is 5,900 feet, *i.e.*, about 900 feet higher than Shillong town. The total area of the farm is 366.67 acres, of which a large portion is occupied by pine forest. Most of the cultivated and culturable land lies in a long narrow valley. The bottom of the valley was formerly a marsh which was of very little value for any purpose, it has recently been converted into firm pasture ground by deepening the stream which drains the valley and opening side drains into it. The effect of this work is now showing in the considerably improved herbage which is produced.

The soil of the higher lands is a coarse reddish loam of very loose texture which can be worked with great ease. The subsoil is of a very pronounced reddish colour and of great depth. In a small portion of the cultivated area the soil is black owing, it is believed, to the existence of some mineral compound. At the bottom of the valley, a different type of soil is found, namely, clay or clayey loam, extremely rich in organic matter. Having long been under a thick growth of grass, the upper portion of this soil is a matted mass of half decayed grass-roots.

In point of quality the soil of the farm is extremely poor, and very little can be grown on it without the help of manure.

The greater part of the station suffers from the disadvantages of an exposed situation. The place is colder and more windy than Shillong; frosts are of very common occurrence and are more severe than in the town. During the winter, the growth of vegetation is entirely suspended.

Purposes of the station. 2. The main objects for which the station is maintained are the trial and introduction of new varieties of potatoes which are the most important among the crops grown on the plateau of the Khasi Hills, the breeding of improved strains of milch cattle suitable for this tract and the cultivation of fodder crops for their upkeep. Fodder experiments have been tried from time to time,

but having proved abortive, they have one after another dropped out of the programme of the farm. Very little experimental work beyond the potato trials is done at present on the farm, and if we leave out the cattle and the fodder crops grown for them, the station may be looked upon more as a seed-growing farm than one devoted to experimental work.

3. The following table gives the rainfall during the official agricultural year under report :—

Weather.				Rainfall.			
				Actual, 1916-17.	Normal.	Number of rainy days, 1916-17.	
1				2	3	4	
1916.							
July	...	...	...	18.78	17.75	23	
August	...	...	...	22.81	15.67	23	
September	...	...	...	11.18	11.06	19	
October	...	...	...	18.78	7.55	15	
November	...	...	...	4.26	1.27	4	
December	...	...	...	0.03	0.18	...	
Total for six months				70.84	53.48	84	
1917.							
January	...	...	...	...	0.29	...	
February	...	...	...	1.82	1.02	4	
March	...	...	...	1.86	2.25	4	
April	...	...	...	.57	4.48	1	
May	...	...	...	11.23	8.83	17	
June	...	...	...	14.84	20.04	21	
Total for six months				30.32	36.91	47	
Total for year				101.16	90.29	131	

These 12 months really cover parts of two different agricultural seasons, as on the plateau of the higher Khazi Hills the cropping season commences in February and ends in November.

The autumn rainfall was heavier than usual and this, while suitable for the winter potato crop, was unfavourable for hay making.

A severe drought in spring checked germination of the potato sets, and delayed the sowing of all fodder crops. A period of heavy rainfall in May and June produced conditions favourable to potato disease, with the result that this year's outturn is likely to prove small.

The other crops will give a smaller outturn than usual. The maize crop is a moderate one, Job's tears and Raishan (*paspalum sanguinale*) are poor, and owing to the early check in growth caused by the drought the upland rice is very light also.

4. The work done during the year included :—

- | | |
|------------------|--|
| Summary of work. | (1) Trials of different varieties of potatoes. |
| | (2) Growing potatoes for seed. |

- (3) An experiment in warping of rice land.
- (4) Trials of new crops.
- (5) Fodder crops.
- (6) Cattle breeding.
- (7) Distribution of seeds, implements, etc.

5. The 13 varieties tested in 1915 were planted in the following year in addition to nine varieties imported from Messrs. Sutton & Sons in 1915, thus making a total of 22 varieties tested in 1916. The newly imported varieties were Magnum Bonum, Up-to-Date, Windsor Castle, Stirling Castle, Epicure, Edinburgh Castle, Dover Castle, Balmoral Castle and Acquisition. Where it was possible each variety was planted in duplicate plots of 1/40th acre each. All the varieties were planted in March and harvested in August, and winter seed was used in each case. The land was manured with 11 tons cowdung and 823 pounds of rape cake per acre, and the crop was sprayed with Bordeaux mixture at the rate of 240 gallons per acre applied in two equal doses.

The outturns of each variety in 1916 and in previous years are exhibited in the following table:—

Statement showing the average yield per acre on duplicate plots for the last nine years.

Variety.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	Average of last five years.	Remarks.	
1	3	3	4	5	6	7	8	9	10	11	12
1. King of Potatoes
2. Magnum Bonum (1908)
3. King Edward VII
4. Khasi Naimital
5. Khasi Round
6. Windsor Castle (1909)
7. British Queen (")
8. Up-to-Date
9. Magnum Bonum (1913)
10. Windsor Castle (")
11. British Queen (")

The year 1916 was the second season for the new varieties and, as usually happens, they have not given a very heavy yield during their first two seasons. However as the seed has now become acclimatised, results more in agreement with those obtained from the older varieties may be expected in future. Epicure, with 4·7 tons per acre, gave the heaviest outturn of the nine new lots. Of the 13 older varieties, Windsor Castle gave the largest crop, Up-to-Date, King of Potatoes and British Queen being very little behind. From the average yields given by these four varieties during the past five years, there would seem to be little to choose between them with regard to their cropping powers.

Of the 22 varieties grown in 1916, Windsor Castle (1909) has been omitted in the present year (1917), as the same variety imported in 1912 has proved slightly superior.

Three other varieties, Arran Chief (1916), King of Potatoes, (1916), and King Edward VII (1916) have been added. The total number of varieties at present under experiment is therefore 24. As the crop is not yet harvested, the results will appear in a future report:—

Varieties.	Number of diseased tubers out of 50 examined.						
	1910.	1911.	1912.	1913.	1914.	1915.	1916.
1	2	3	4	5	6	7	8
King of Potatoes	12	Nil	Nil	Nil	1	5	3
Magnum Bonum (1908)	6	4	2	4	2	Nil	1
King Edward VII (1908)	18	8	4	6	5	4	1
Khasi Nainital (1908)	48	16	8	4	4	8	Nil
Khasi Round (1900)	4	8	6	10	6	6	10
Windsor Castle (1909) ... ..	...	...	4	3	3	12	2
British Queen (1909)	12	...	6	4	2	8	2
Up-to-Date (1909)	4	32	16	4	1	6	4
Magnum Bonum (1912) ... ..	...	...	6	6	2	2	1
Windsor Castle (1912) ... ..	...	...	4	3	2	10	1

Varieties.	Number of diseased tubers out of 50 examined.						
	1910.	1911.	1912.	1913.	1914.	1915.	1916.
1	2	3	4	5	6	7	8
British Queen (1912)	4	4	3	6	1
Flour Ball (1912)	6	2	1	10	1
Imperator (1912) &	22	9	2	4	6
Stirling Castle (1915)	10
Epicure (1915)	5
Magnum Bonum (1915)	5
Dover Castle (1915)	4
Up-to-Date (1915)	1
Windoor Castle (1915)	2
Edinburgh Castle (1916)	3
Balmoral Castle (1915)	5

Potato disease caused by *Phytophthora Infestans* is often responsible for considerable damage to the potato crop in the Khasi Hills. This year the damage to the farm crop was greater than usual, owing to growth being delayed by an early drought, which was followed by rather heavy rainfall in May and June, and an early appearance of potato blight. Preventive spraying is as thoroughly and systematically carried out on the farm every year as weather conditions permit.

In the present year part of the crop was sprayed twice with Bordeaux mixture, at 120 gallons per acre each time, the balance being sprayed once at the same rate.

Notwithstanding this treatment, growth ceased early, and the crop is yielding a smaller outturn than in the previous year.

The seven new types of potatoes, bred at the farm in 1914 from seeds of the variety Flour Ball, and grown since that time, were planted again in the spring of 1916. Their respective

yields are as follows :—

						Area.	Quantity planted.	Yield per acre.
1						2	3	4
						Acres.	Seers.	Tons.
Type	I	...	...	...	...	1/80	5	5.79
"	II	...	...	...	...	1/80	5	3.03
"	III	...	...	...	...	3/160	5	4.01
"	IV	...	...	...	...	1/80	4½	3.44
"	V	...	...	...	...	1/40	10	5.63
"	VI	...	...	...	...	1/80	5½	4.44
"	VII	...	...	...	...	1/160	3½	3.23

The plots were manured with cowdung at 11 tons, and rape cake at 823 pounds per acre.

Although a certain amount of selection has been done with these types, they do not yet seem to be pure. They have been further selected this year and are being tested on a field scale again this season.

Twenty lots of seed were obtained in February 1916 from St. Andrew's University, through the kindness of Mr. Donald Ferguson of Dhamai Tea Estate, Sylhet, Honorary Correspondent of the Department. Half of each lot of seed was sown in boxes on 20th February 1916, and the remaining half was sown similarly on 19th March 1916. Out of the twenty lots numbers four and twenty failed to germinate. The others grew satisfactorily, and the seedlings were planted in the field on the 15th March 1916.

Two lots of seed produced only one plant each, and as one of these plants failed to form any tubers, the total number was reduced to nineteen. Two lots were destroyed by insects and the remaining seventeen gave widely varying yields. The potatoes obtained from them were again planted in the present year. The results have not yet been obtained, but there were several promising types among them. As seedling potatoes generally require to be grown for two or three seasons before they give anything like their full yield, little information can be expected until these have been tested on a field scale for another year.

Potato manurial experiment.—An experiment designed to shed some light on the respective manurial values of rape cake and bonemeal for the potato crop was laid down in 1916 and repeated in the present year. This experiment was put down in duplicate on a series of plots of King of Potatoes, and a similar duplicate experiment was carried out with Magnum Bonum. The seed-rate was 987 pounds per acre. The manures used and the yields obtained per acre in 1916 are shown in the accompanying table :—

1	2	3	4	5	6
Manures used per acre.	Cowdung 5·5 tons.	Cowdung 5·5 tons, rape cake 823 pounds.	Rape cake 823 pounds.	Bonemeal 823 pounds.	Cowdung 5·5 tons, bonemeal 823 pounds.
	Tons.	Tons.	Tons.	Tons.	Tons.
King of Potatoes	5·17	7·35	2·92	4·49	6·90
Magnum Bonum	3·94	6·56	2·77	4·56	5·82
Total	9·11	13·91	5·69	9·05	12·72
Average yield per acre	4·55	6·95	2·84	4·52	6·36

Bonemeal and rape cake were used, not because they were considered the most suitable for the potato crop but because they are practically the only manures, other than cowdung, which are known to the cultivators of the Khasi Hills.

From the yields obtained it would seem that under the conditions prevailing on the Upper Shillong Farm, while rape cake is more effective than bonemeal as a supplementary dressing with cowdung, yet when used alone, bonemeal gives much better results than the rape cake. These manures are again under experiment in the present season, and the results will appear in next year's report.

6. Six varieties of potatoes were grown during the present year for the purpose of seed, namely, King of Potatoes, Magnum Bonum, Up-to-Date, Windsor Castle, British Queen and Imperator. The crop was planted in March and has just been harvested. The total area planted was 7·4 acres as against 3·1 acres in 1916. The manures

used were, as in previous years, 5.5 tons of cowdung, and 823 pounds of rape cake per acre. The crop was sprayed once with Bordeaux mixture at the rate of 120 gallons per acre. The outturn was as follows :—

Variety.			Area, in acre.	Total yield.
1			2	3
				Tons.
King of Potatoes	...	...	2.35	7.08
Magnum Bonum	...	...	2.075	6.29
Up-to-Date	...	...	1.325	4.14
Windsor Castle	...	...	1.15	4.82
British Queen (1909)	...	...	.25	.74
Imperator	...	...	.25	1.03
Total	...	...	7.4	23.9

The average yield per acre amounted to a little over 3.2 tons against 5.5 tons in 1916.

The demand from the plains for seed potatoes grown on the Shillong Farm is extending rapidly. In order to meet this increased demand, the area under this crop has been extended as far as practicable with the quantity of cattle manure which is available. Even then there is insufficient supply for the requirements of both hills and plains districts. To still further increase the supply, arrangements were made in 1916 to cultivate an extra area of potatoes under the *jhum* system. In that year an area of $16\frac{1}{2}$ acres was planted on the farm lands according to this system.

An agreement was made with Khasi cultivators to carry out this work. The terms were that the farm should provide the land and the seed, and that the cultivators should do the work, and return to the farm one and a half times the seed supplied. The cultivators also undertake to sell at bazaar rates whatever additional quantity might be required. In 1916, the farm supplied for this purpose 6.65 tons and in return received 10.78 tons. This included .8 ton received as payment for the work of spraying the crop with Bordeaux mixture, which was done by the farm workers.

In the present year 10½ acres are being cultivated under a similar agreement. The farm supplied 2·92 tons and it is expected that the return will be about 4·7 tons. The total quantity of potatoes available for disposal last year (1916) was 56·13 tons made up as follows :—

	Tons.
Farm-grown crop, taking summer and winter crop together.	30·75
<i>Jhum</i> grown	10·78
Purchased from <i>jhum</i> cultivators ...	14·60
Total	56·13
This quantity was disposed of as follows :—	
Sold to Khasi cultivators	7·56
Supplied to Gaubati Seed Depot and other places in the province through the Agricultural officers.	21·73
Sold direct from the farm to officials and private individuals outside Khasi Hills.	2·16
Total quantity supplied for seed ...	31·45
Used on the farm and the <i>jhum</i> area for planting ...	20·
Feed of farm stock	·54
Dryage and rottagc	4·14
	24·68
Total	56·13

The price charged to Khasi cultivators for seed potatoes supplied was the market price for table potatoes for the time being, and varied last year between Rs. 2·8 and Rs. 2·12 per maund, against a slightly higher rate charged in the previous year.

While in storage on the farm the potatoes kept rather better than in the previous year. A small quantity of damaged potatoes and of potatoes which were unsuitable for seed were fed to the farm stock.

The seed potatoes sold consisted of 9·32 tons of King of Potatoes, 13·76 tons of Magnum Bonum, 4·73 tons Up-to-Date, 3·52 tons of Windsor Castle and the balance of the minor varieties.

7. Experience during the past few years showed that some land which had been reclaimed in 1912-13 from a marsh for the purpose of rice cultivation was still unfit for the crop. The sterility of the soil was believed to be due to the fact, that the upper

Warping of rice land.

layer was mostly composed of tough grass roots, which were slow to decay, and it contained very little of what might be called real soil. An experiment was made during the year 1915, to see if the land could be brought into a fit condition for growing rice by a process known as "warping," which consists in covering the land with a layer of soil deposited from water. This method is used by the Khasis for renovating worn-out rice land.

One acre of land out of the area reclaimed in 1912-13 was taken for the purpose of this experiment. A slow current of water laden with soil thrown into it at a higher level, was made to flow over the land. By shifting the current from place to place the whole area was gradually covered with a layer of silt about 3" thick. It was a rather costly operation, the total cost being no less than Rs. 128 for the one acre of land.

The land which is divided into 10 equal plots of $\frac{1}{10}$ th of an acre each, was sown with wet rice in the spring of 1915, and alongside it some similar but untreated land was sown at the same time for comparison. A better crop was obtained than in the previous year, although it was still a light one. The yield on the warped land was 831 pounds of grain and 1,600 pounds of straw per acre, while on the unwarped land the rates were 730 pounds of grain and 1,405 pounds of straw. This increased yield of 101 pounds of grain and 195 pounds of straw was a very small one considering the expenditure incurred. As it was expected that a greater difference might be shown in the following year, the experiment was continued. A heavy rainfall set in when the seed was germinating and caused an extra flow of water which damaged part of the area, and so rendered the experiment unfit for comparison. The experiment is being continued in the present year.

8. *Buck wheat*.—This crop has been recently introduced into the district by Nepalese settlers, and although the returns have not been very large, it seems to have possibilities on the Khasi Hills, as the cost of cultivation is so small. When the seed is sown immediately after the potatoes have been dug, no extra cultivation is required. On the farm this course was followed satisfactorily for the first two years of the experiment. In 1915, the crop grew very well until the frosts set in, which unfortunately was rather early in the season. Afterwards little growth was made and the yield was disappointing. The 1916 crop met with a similar fate and was not worth harvesting. In the present year precautions are being taken to sow early, and it is hoped that this crop may be fortunate enough to escape the frosts.

This crop was first planted in 1912, on a plot of land about $\frac{1}{10}$ th of an acre in extent. A further plot of $\frac{1}{20}$ th of an acre was planted in 1915. The land was manured with cowdung in the winter of 1916-17, at the rate of 11 tons per acre.

The plants grew vigorously and a total of 377 pounds of stalks was sold, realising Rs. 45-14.

The plants are continuing to grow well.

In September 1916 an additional plot of $\frac{1}{20}$ th acre was planted with two varieties of strawberries obtained from the fruit garden, Shillong. These plants have grown well.

The plot of $\frac{1}{20}$ th acre planted in 1914 was manured last winter with cowdung and bonemeal at the rate of 11 tons and 247 pounds, respectively.

These plants are growing well, but owing to the severe spring drought, they flowered late in the season and the crop was a short one.

About ten pounds of fruit have been picked and sold during the year, and the return therefrom was Rs. 13.

A few of the trees on the farm bore fruits. These were sold and realised the following sums :—

				Rs. a. p.
Apples	...	...	...	32 7 6
Peaches	...	...	...	5 13 0
Chestnuts	...	...	...	6 12 0

9. The following fodder crops were grown during the year :—

Names of crops.			Area sown.	Cost of cultivation.	Outturn of green fodder.
			Acres.	Rs. a. p.	Tons.
Maize	...	...	9.1	266 5 10	32.53
Job's tears	...	...	3.84	155 6 4	2.75
Thum area	...	...	8 approximate.	.....	17.0
Total	...	...	20.85	461 12 2	52.28

The maize crop gave a fair yield. Job's tears did well on the *jhum* area, but the farm crop was poor.

The whole of this fodder (52.77 tons) was made into ensilage. From this quantity of green material 35.59 tons or 67 per cent. was recovered as ensilage of good quality.

The total cost of silage was Rs. 688-2, made up of cost of cultivation Rs. 421-12-2, cost of carrying the fodder, chopping, and packing in the Silo Rs. 266-5-10.

The proportion of loss through decay around the sides of the pit in which the ensilage was made, was not very heavy, although greater than in the previous year. The cost per ton of silage was Rs. 19-6 as compared with Rs. 26-8 in the previous year. The lower cost this year was the outcome of the much larger quantity of crop dealt with.

Raishan (*Paspalum sanguinale*) has been successfully grown as a hay crop since 1912 and has proved a valuable winter food for the cattle. *Raishan* was grown on an area of 9.3 acres and the produce was made into hay and fed to the cattle during the winter months.

A total amount of 16.18 tons of hay was fed during the year. The cost was Rs. 551, or a little over Rs. 34 per ton of hay.

The quality of this fodder was good, and all was eaten by the cattle.

Cattle breeding. 10. The following table shows the number of cattle in the herd on 30th June 1917 :—

Description.	Montgomery.	Patna (P).	Bhutia B.	P × B.	P × B P.	P × B × P × P.	P × B × P × P × P.	P × Khasia (K).	Total on 30th June 1917.	Total on 30th June 1916.	Total on 30th June 1915.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13
Breeding bulls	...	1	...	...	...	...	...	...	1	2	2	Are being used as plough cattle.
Bulls (3 years and above)	1	...	...	...	...	2	5	4	3	
.. (2 to 3 years)	2	...	1	3	1	...	7	3	5	
.. (1 to 2 years)	3	...	...	1	4	...	8	9	3	

Description.	Montgomery.	Patna (P).	Bhutia (B).	P x M.	P x B x P.	P x B x P x P.	P x B x P x P x P.	P x Khasi (K).	Total on 30th June 1917.	Total on 30th June 1916.	Total on 30th June 1915.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13
Bulls (under 1 year)	5	...	...	...	1	...	...	6	8	10	
Heifers (2 to 3 years)	3	...	...	4	3	...	...	10	9	5	
" (above 3 years)	1	...	...	...	...	...	...	1	...	...
" (1 to 2 years)	9	...	1	3	...	...	...	12	6	9	
" (under 1 year)	3	...	1	1	...	4	...	9	13	7	
Cows	13	1	6	3	6	...	...	39	25	21	
Total on 30th June 1917	1	40	1	9	14	15	4	...	86	...	...
Total on 30th June 1916	...	38	1	9	14	13	1	2	...	78	...	
Total on 30th June 1915	...	31	1	9	12	9	...	2	...	...	64	

In addition to the above, there were three Hindustani and 8 Khasi bullocks. The total number of cattle was, therefore, 97 against 88 on the corresponding date of last year.

During the year under report the following cattle were bought locally :—

One Montgomery bull was purchased for breeding purposes from the Roman Catholic Mission at a price of Rs. 180.

Two Khasi plough bullocks were purchased to replace a pair that had become useless owing to advanced age.

The demand for bulls bred at the farm still far exceeds the supply. During the past year 8 bulls were sold, viz., two breeding bulls sold because they had become useless owing to old age, three young Patna bulls sold to cultivators in the Khasi Hills,

one Patna bull and one Patna × Bhutia × Patna bull sold to tea-garden Managers in the Surma Valley, one Patna × Bhutia bull sold to a Khasi cultivator.

The total yield of milk during the year amounted to 2,585 gallons, out of which about 84 gallons were fed to calves, and the remainder was sold at the rate of 14 lbs. for the rupee.

The cost of maintenance of the herd amounted to Rs. 3,712-9-8 against Rs. 4,485-4-9 in the previous year. The income from the sale of milk amounted to Rs. 1,854-5-6 against Rs. 1,949-8-6, and the value of the cattle sold to Rs. 327 against Rs. 180 in the previous year.

The half English Patna cattle and the progeny of their cross with Khasi and Bhutia breeds have proved remarkably well adapted to the climate of the Khasi Hills. In respect of milking capacity, these cattle stand head and shoulders above any cattle on this side of India.

After many years of work, we have got together a fine stock of milk cattle, the like of which is not to be seen within many hundred miles of Shillong, and which promises to improve further by selection and crossing. It would be a comparatively easy matter to increase the herd so as to make it possible for us to sell cows and heifers to the public. There is a great demand for female stock bred at Upper Shillong, but we cannot afford to sell any at present. Some of our cows might easily fetch Rs. 200 or more if offered for sale.

The cost of maintaining the herd is still high. It has been reduced considerably in recent years, and it would seem that still further reduction is possible. It might be possible to reduce the expenditure by separating the cows from the rest of the herd and maintaining them purely with a view to profit.

That the Upper Shillong cattle are being more and more appreciated is evident from the growing desire of cow owners in the Shillong station for the services of bulls bred on the farm.

The former breeding bulls were too old and had to be sold off. The proposal to purchase an Ayrshire bull had to be dropped owing to the difficulties of importing an animal from abroad at the present time.

The present herd of Patna cattle is far superior to the cattle of the province, and it would undoubtedly be advisable to maintain this breed. Several attempts have been made to obtain young bulls from the Patna district, but owing to indiscriminate breeding in that district in recent years, it has been so far found impossible to procure bulls of the desired type.

As neither Ayrshire nor Patna bulls were obtainable, the above mentioned Montgomery bull was purchased and for so far has proved satisfactory.

Distribution of seed
and plants.

11. The following were the seeds and plants supplied to agriculturists during the year :—

	Tons.	Number.
Seed potatoes	31.47	...
Rhubarb roots ... ..	...	58
Strawberry plants ... ..	...	74
Pear grafts ... ..	...	110
Fig cutting ... ..	...	10
Oil cake for manure	45	...

Establishment.

12. Mr. Herrick Sing continued in the position of Farm Manager during the year.

U Bendramoney occupied the position of Farm clerk throughout the year.

Of the three apprentices who were in training at the beginning of the year, Paschalís Hoverwell has since been appointed Agricultural Demonstrator in the North Cachar Hills. Rodie Singh resigned his apprenticeship. H. W. Momin who was specially sent from the Garo Hills has been appointed Demonstrator for his native district. Two new apprentices were appointed to the vacant apprenticeships, *viz.*, Gloschon Singh appointed on 26th July 1916, and Sedro Singh appointed on 1st November 1916. In addition to these two apprentices, two Garo candidate apprentices are being entertained. These young men work with the labourers and are paid at the ordinary rates.

13. The total receipts, including the value of seed potatoes for demonstration purposes in the Assam and Surma Valleys, were Rs. 4,516-12-6 against Rs. 5,656-14-11 in the previous year.

The sale of milk produced Rs. 1,854-15-6, the sale of cattle Rs. 327, while potatoes sold direct from the farm realised Rs. 867-2, and in addition, potatoes to the value of Rs. 1,107-13 were supplied for demonstration purposes throughout the province.

The total expenditure for the year amounted to Rs. 14,014-7-9 against Rs. 12,299-5-4 in the previous year. The increase in expenditure was due to two items, *viz.*, the purchase of cattle and a sum of Rs. 1,293 spent on erecting a permanent wire fence.

SHILLONG:

J. W. MCKAY,

The 23th August 1917.

Deputy Director of Agriculture,
Surma Valley.

ANNUAL REPORT OF THE FRUIT EXPERIMENT STA
TION, SHILLONG, FOR THE YEAR ENDING TH
30TH JUNE 1917.

1. *Introductory.*—The Fruit Station commenced work in October 1913—Planting was commenced in the spring of 1913. The land is situated on the south side of the Jowai road, distant about a mile from Shillong. The elevation is about 5,100 feet. The total area of the grant is 57.41 acres, of which about 25 acres is suitable for fruit growing—23 acres have been planted.

2. *Lower garden.*—No extension to this block has been made since 1913-14 and the planted area remains at $4\frac{1}{4}$ acres in grounds of 6.13 acres—the fruit trees are planted $15' \times 15'$ diagonally. The soil of this block varies from light sandy loam lying above stone to heavier loam of good depth. The trees on the heavier loam continue to improve in growth and yield the following varieties on this soil have so far yielded best:—James Grieve, Kerry Pippin, Sturmer Pippin, Bens Red, Bismarck, Peasgood's Nonsuch, Alfriston, Red Victoria: the following varieties have yielded sparsely:—Red Juneating, Warner King, Hounslow Wonder, Cox's Orange Pippin, Hector Mac Donald, Coe's Golden Drop, Scarlet Nonpareil, Golden Reinette, Devonshire Quarrenden, Yellow Ingestre, Ardcairn Russet, William Crump. On the lighter soil only the stronger growing varieties of apples planted have succeeded, *viz.*—Encore, Bramley's Seedling, Crimson Bramley, Newton Wonder, Lady Sudeley, Norfolk Beauty, Peasgood's Nonsuch, Alfriston, Lane's Prince Albert, Allington Pippin, Kerry Pippin, Potts Seedling, Rymer. The varieties Sanspareil, Duke of Devonshire, Allen's Everlasting Beauty of Bath, Ribston Pippin, have been removed to a Nursery on stronger soil. In their place the varieties Bismarck, Worcester Pearmain, Grenadier, Star of Devon, Upton Pyne, Rev. W. Wilks, have been planted.

The Pear trees are improving in growth, the following varieties flowered, and set fruit:—William bon Chretien, Fondant Thirriot, Fondante d' Automne, Fertility, St. Swithins, Roosevelt, Marguerite Marillat, Doyenne du Comice. Of these varieties, as far as can be judged now, Fertility should be a good market pear—St. Swithins is an early variety, but is small and a poor keeper.

the Fondante d' Automne upright trained trees are bearing well—a delicious melting pear: Marguerite Marillat is a large and handsome pear. The William bon Chretien and Marguerite Marillat trees show a weak growth on the Quince stock, but may improve. The Fondante Thirriot is a large pear of good flavour, and promises well.

The Cherry trees have grown well: the varieties "Kentish" and "Morello" were the only ones to bear fruit. The Duke of York, Peregrine, and Kestrel, Peach trees bore good well coloured fruit.

The Plum trees planted on the lighter soil have not succeeded. Weston's Superb, Belle de Louvain, Belgian Purple have been set for further trial, and the others have been removed to a nursery on stronger soil—Shepherd's Bullace, and Merryweather's Damson have grown well on the heavier loam, and show great promise of yielding good crops. Merryweather's Damson is all raisers Messrs. Merryweather & Sons claim for it; it could easily be mistaken for a late plum until tasted. Although the tree is so much above that of the largest Damson grown, the true flavour of the Damson is retained. The Giant Himalaya, Berry California and the Blowers are the best of the varieties of blackberries; and the King's Acre Berry the best of the Hybrid berries. The fruit of the Hawthorn-leaved Berry (*Rubus Crataegolius*) is worthless and this variety will be discarded. The raspberries are not a success; they bear the year after they are planted, but the growth of the new canes in following years is weak. The varieties, the Devon and Royal, transplanted last year to the upper garden show no improvement. The autumn fruiting variety November Abundance is the only variety that shows any promise of succeeding. Royal Sovereign, Laxton Superb, and Givons Late Prolific, Strawberries yielded good crops. Gooseberries have failed, and are not suitable for the climate. Red and white currants show no promise of succeeding: Black Currants may succeed on a suitable site: the trees in this garden have been transplanted to shady sites in the upper garden. The land has been well cultivated during the year.—The lighter soil, when deeply dug in the cold weather, was found to be infested with the Cockchafer grub which have attacked the surface roots of the majority of the Apple and Plum trees: the soil round all of the trees was removed and the grubs killed. The greater percentage of the Apples gathered have been worm free, but Calyx spraying and later applications during summer will have to be done to ensure good crops of sound fruit.

3. *Upper garden*.—The area planted is $18\frac{3}{4}$ acres, of which $10\frac{1}{2}$ acres was planted in 1914, 2 acres in 1915, $\frac{1}{2}$ an acre in 1916, $5\frac{1}{4}$ acres in 1917. It is divided into 6 blocks, *viz.*:—

Top block.—Area $1\frac{2}{3}$ acres, planted in 1914 with Bush Apple trees $15' \times 15'$ diagonally.

North block.—Area $1\frac{1}{2}$ acres, planted in 1914 with Standard Apple trees $31' \times 31'$ diagonally, interplanted with Bush Apple trees $17' \times 17'$.

South block.—Area $4\frac{1}{4}$ acres, planted with Standard Apple trees $30' \times 30'$ diagonally, partly interplanted with Bush Apple, Pear, and Almond trees $15' \times 15'$ — $\frac{3}{4}$ acre planted in 1914, $1\frac{1}{4}$ acre planted in 1915, $\frac{1}{2}$ acre planted in 1916, $2\frac{3}{4}$ acres planted in 1917.

East block.—Area 7 acres, planted with Standard Apple trees $34' \times 34'$ diagonally, interplanted with Bush Apple trees $17' \times 17'$ — $5\frac{1}{2}$ acres planted in 1914, $1\frac{1}{2}$ acres planted in 1915.

East block extension.—Area $2\frac{1}{2}$ acres, planted in 1917 with Standard Apple trees $30' \times 30'$ diagonally, interplanted with Bush Apple trees $15' \times 15'$.

West block.—Area $1\frac{1}{4}$ acres, planted with Standard Pear tree $25' \times 25'$ diagonally, interplanted with Bush Pear trees $12'-5" \times 12'-6"$ —1 acre planted in 1914, $\frac{1}{4}$ acre planted in 1915.

In the south block only 2 acres of the $4\frac{1}{4}$ acres has been interplanted with Bush trees.

The soil of the Upper garden is a good loam of about 12 inches depth lying on a reddish sub-soil. Small plots have a hard pan sub-soil about $2\frac{1}{2}$ feet from the surface. The whole of the planted area has been terraced with stone and banks. It has successfully prevented the denudation of the soil by rainfall.

Five hundred Paradise stock and 1,100 Kashmir Crab stock for Apple grafting are planted 3 feet apart in rows between the trees in the East block. Similarly, 1,500 Devonshire Crab stock have been planted in the North and Top blocks; and 1,000 Quince stock and 800 Pear stock for Pear grafting in the West block.

The following Apples and Pears were grafted successfully in July and August 1916 on stock in the East and West blocks:—4 Fertility Pears and 420 Apples of the following varieties:—4 Bismarck, 73 James Grieve, 52 Kerry Pippin, 15 Lane's Prince Albert, 17 Rev. W. Wilks, 4 Stirling Castle, 7 Red Victoria, 2 Crimson Bramley's Seedling, 20 Bramley's Seedling, 40 Alfriston 25 Bens Red, 48 Rival, 55 Domino. The following varieties of

Apples in the Upper garden have so far yielded best of the Bush trees:—James Grieve, Lane's Prince Albert, Upton Pyne, Stirling Castle, Bismarck, Rev. W. Wilks, Domino, Rival, Baumann's Reinette, Brownlee's Russet, Red Victoria, Sturmer Pippin, Emmeth Early, William's Favourite, Kerry Pippin, Peasgood's Non-such, Lady Sudeley, Mr. Gladstone, Encore, Bramley's Seedling, Newton Wonder, Charles Ross, Crimson Bramley's Seedling, Bens Red, Alfriston, Cardinal. The following varieties have yielded sparsely—Boston Russet, Claygate Pearmain, Mannington Pearmain, Red Juneating, Flower of Kent, Barnack Beauty, Norfolk Beauty, Christmas Pearmain, Royal Snow, Houblon, Wellington, Devon Queen, Renown, Rymer, Thomas Rivers, Grenadier, Potts Seedling, Wadhurst Pippin, Ecklinville Seedling, Scarlet Nonpareil, Beauty of Bedford, Reinette dorée de Heusgen, Ardeairn Russet, Allington Pippin, William Crump, Herrings Pippin, Beauty of Bath, Golden Spire, Irish Peach.

The following varieties have not yet borne fruit—Egremont Russet, Annie Elizabeth, Lord Hindlip, Blenheim Orange, Winter Quening of Kent, Pineapple Russet, Edward VII, Coronation, Wealthy, Feltham Beauty, Yorkshire Beauty, Kings Acre Pippin, Golden Russet, Roundway Magnum Bonum, Warners King, Hounslow Wonder, Hector MacDonald, Court Pendu Plat, Gascognes Scarlet, Spitzenberg, Braddick's Nonpareil, White Nonpareil, Pitmaston Pineapple, Langley Pippin, Wagener, Lord Burghley, St. Everard, Coe's Golden drop, Fearn's Pippin, Spring Ribston Pippin, Rosemary Russet, Early Peach, Newtown Pippin, American Mother. Only a few of the Pear trees flowered or set fruit, the variety "Princess" flowered profusely, but one tree only bore fruit. It is probably self sterile and other varieties flowering at the same time will have to be planted near it: it is a seedling from Louise Bonne of Jersey, and in size and colour it resembles the parent, large, flesh melting, flavour very good. The other varieties that set fruit were Marguerite Marillat, William bon Chretien, Fertility; Doyenne d'Ete. The latter is a small very early pear. None of the English Plum trees did well; the American varieties—Shiro, Gold, Omaha have grown well, and it is hoped will fruit next year. None of the Orange trees have yet borne fruit. The whole area of the upper garden has been well cultivated and the trees have put on very satisfactory growth—Kerry Pippin and James Grieve have yielded best of the dessert varieties of Apples; and Rev. W. Wilks, Bismarck and Alfriston, of the culinary varieties. Three thousand Royal Sovereign Strawberry runners were planted out in the East block in October, and have grown well.

5½ acres was added to the planted area this year. The American varieties of Apples, Delicious, King David, Black Ben, Grimes Golden, planted in the South block should succeed, judging from the growth of the trees in the Nurseries. The whole of the planted area has been fenced with Page's wire fencing 4'-10" high.

The following trees are in Nurseries for future planting :—

Description.	South block, 1915 and 1916, trees.	South block, 1917, trees.	East block, 1915, trees from Kashmir.	East block, 1915 and 1916, trees.	Total.
1	2	3	4	5	6
Standard Apple trees ...	175	18	210	560	663
Bush " " ...	...	...	...	...	...
Standard Pear " ...	80	12	41	...	133
Bush " " ...	...	...	...	...	...
Cherry " ...	...	...	18	...	18
Apricot " ...	...	...	7	...	7
Walnut " ...	...	...	4	...	4
Plum " ...	11	6	4	98	119
Almond " ...	...	...	20	...	20
Sweet Chestnut " ...	6	...	...	...	6
Pecan Nut " ...	9	...	...	...	9
Black Currant " ...	24	...	...	...	24
Red " " ...	5	...	...	...	5
White " " ...	5	...	...	...	5
Gooseberry " ...	4	...	...	...	4

The establishment consists of an Overseer on a monthly salary of Rs. 25, 2 Khasi Apprentices, and 8 Khasi *malis* on a monthly salary of Rs. 15 each. All have worked well and take great interest in their work.

4. *Varieties planted.*—The following statement shows the number and varieties of fruit trees planted :—

Species of fruit trees.	Variety.	Planted 1914-17.						Planted 1918.	Total number.	Description.
		Upper garden.								
		Top block.	South block.	East block.	North block.	East extension.	Lower garden.			
1	2	3	4	5	6	7	8	9	10	
Apple trees ...	James Grieve ...	59	74	146	58	...	44	381	Bush.	
	Boston Russet ...	...	2	12	...	...	...	14
	Bens Red ...	...	...	10	10	...	9	29
	Alfriston ...	...	...	30	...	...	8	38
	Egremont Russet ...	10	...	...	8	1	...	19
	Annie Elizabeth ...	...	...	20	...	...	...	20
	Claygate Pearmain ...	8	...	...	10	...	...	18
	Lord Hindlip ...	...	...	10	...	...	...	10
	Mannington Pearmain ...	6	...	...	8	2	4	20
	Winter Queening of Kent.	...	...	10	...	...	...	10
	Pineapple Russet ...	...	...	...	9	...	...	9
	Edward VII ...	...	...	9	...	...	...	9
	Red Juneating ...	6	...	...	2	...	10	18
	Flower of Kent ...	...	...	8	...	...	...	8
	Cornish Pine ...	2	...	11	...	...	1	14
	Tower of Glamis ...	...	...	...	...	6	...	6
	Winter Banana ...	...	...	...	...	3	...	3
	Wolf River ...	...	...	...	...	3	...	3
	Chelmsford Wonder ...	...	...	...	...	6	...	6
	Ryford Wonder ...	...	...	...	...	10	...	10
	Ruddy ...	...	...	...	...	6	...	6
	Ormead Pearmain ...	...	...	...	...	6	...	6
	Hambledon deux ans ...	...	...	...	...	5	...	5
	Belle de Fontenay ...	...	...	...	...	5	...	5
	Barnack Beauty ...	...	...	...	6	8	5	19
	Coronation ...	...	...	6	4	...	5	15
	Wealthy ...	...	...	...	4	...	6	10
	Feltham Beauty ...	...	...	10	...	...	...	10
	Norfolk Beauty ...	8	...	...	10	...	10	28

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1918.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	East extension.			
1	2	3	4	5	6	7	8	9	10
Apple trees	Christmas Pearmain...	10	10	Bush.
	Yorkshire Beauty ...	5	...	...	1	...	...	6
	Kings Acre Pippin ...	...	...	8	...	...	...	6
	Crimson Bramley ...	15	...	18	...	...	5	38
	Royal Snow ...	...	...	10	...	...	...	10
	Bramley's Seedling ...	15	...	15	...	...	15	45
	Kings of Tompkins County.	1	...	7	2	...	...	10
	Houblon ...	...	...	6	...	...	...	6
	Roundway Magnum Bonum.	6	...	...	...	...	2	8
	Wellington ...	...	...	5	...	...	...	5
	Lane's Prince Albert	14	2	19	...	10	11	56	
	Upton Pyne ...	1	3	6	...	...	...	10
	Devon Queen ...	4	1	2	...	3	...	10	
	Renown ...	...	...	4	...	...	6	10
	Stirling Castle ...	10	...	10	...	...	...	20
	Golden Russet ...	...	...	6	...	...	...	6
	Charles Ross ...	10	...	10	...	11	...	31	
	Bismarck ...	...	...	17	8	...	19	44
	Rymer ...	6	...	...	...	...	...	6
	Warner's King ...	...	...	...	...	...	11	11
	Thomas Rivers ...	10	...	...	...	...	...	10
	Grenadier ...	...	2	17	...	...	3	23
	Rev. W. Wilks ...	10	...	6	...	...	6	31
	Hounslow Wonder ...	...	1	20	...	...	6	27
	Newton Wonder ...	15	...	21	...	...	16	52
	Red Victoria ...	...	4	11	...	3	10	28
	Potts' Seedling ...	4	...	5	...	...	10	19
	Hector McDonald ...	...	...	20	...	...	10	30
	Emperor Alexander ...	...	9	1	...	...	...	10
	Sandringham ...	...	...	...	...	6	...	6
	Reignmont ...	...	...	...	...	6	...	6

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1913.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	East extension.			
1	2	3	4	5	6	7	8	9	10
Apple trees	Hamblings Seedling...	5	6	...	6	Bush.
	Gabalva ...	...	...	...	...	6	...	6
	Baron Wolsey ...	...	...	...	...	6	...	6
	Loddington Seedling	...	...	...	...	6	...	6
	Parroquet	...	...	...	...	6	...	6
	Domino ...	13	...	...	...	...	...	13
	Rival ...	...	...	16	...	12	...	28
	Wadhurst Pippin	10	...	...	...	...	...	10
	Court Penda Plat	6	...	6	...	...	...	12
	Ecklinville Seedling	4	...	4	...	...	...	8
	Early Red Margaret	...	...	10	...	...	...	10
	Gascoyne's Scarlet	4	...	5	...	...	...	9
	Spitzenberg	...	...	6	...	...	...	6
	Braddicks Nonpareil...	5	...	...	...	...	...	5
	White Nonpareil	10	...	...	...	...	...	10
	Baumann's Reinette...	6	7	8	...	4	...	25	
	Pitmaston Pineapple	10	...	...	...	...	...	10
	Brownlee's Russet	10	...	...	...	...	...	10
	Sturmer Pippin	5	6	16	...	...	20	47
	Cardinal	...	...	9	1	...	...	10
	Emmett Early	...	3	16	...	8	...	27	
	Langley Pippin	...	...	10	...	...	...	10
	Wagener	...	...	9	...	...	...	9
	Williams' Favourite	10	...	...	...	...	...	10
	Scarlet Nonpareil	...	...	10	...	...	12	22
	Lord Burghley	1	...	...	...	4	2	6
	St. Everard	...	6	...	...	4	...	10
	Beauty of Bedford	...	3	...	...	7	...	10
	Reinette doree de Housgop.	10	...	...	...	...	...	10
	Cox's Golden Drop	...	...	...	...	...	6	6
	Cox's Orange Pippin...	...	...	...	...	...	23	23

Species of fruit trees.	Variety.	Planted 1914-17.						Planted 1918.	Total number.	Description.
		Upper garden.								
		Top block.	South block.	East block.	North block.	East extension.	Lower garden.			
1	2	3	4	5	6	7	8	9	10	
Apple trees	Kerry Pippin	...	10	16	10	36	Bush.	
	Golden ReINETte	...	...	...	...	...	6	6
	Peasgood's Nonsuch...	...	...	20	...	...	14	40
	Fearn's Pippin	...	...	12	...	...	6	18
	Lady Sudeley	...	...	20	...	...	10	30
	Devonshire Quarrenden	...	...	...	...	...	17	17
	May Queen	...	10	...	...	...	...	10
	Royal Jubilee	...	8	...	...	...	...	8
	Missing Link	...	1	...	...	...	...	1
	Roseberry	...	1	...	...	...	...	1
	Crawley Beauty	...	1	...	...	...	...	1
	Mrs. Phillimore	...	...	...	...	6	...	6
	Lord Grosvenor	...	...	...	...	6	...	6
	Blue Pearmain	...	...	...	...	4	...	4
	Jefferson	...	...	...	...	7	...	7
	Star of Devon	...	...	...	...	20	6	26
	Yellow Ingestre	...	...	...	...	...	6	6
	Upton Eyre	...	...	...	...	25	6	31
	Ardcairn Russet	...	7	6	1	11	5	30		
	Allington Pippin	...	16	5	...	...	4	25
	William Cramp	...	8	10	...	12	6	45		
	Worcester Pearmain...	...	...	...	...	...	6	6
	Herring's Pippin	...	4	6	3	...	52	1		66
	Beauty of Bath	1	5	1		7
	Ellison Orange	...	...	...	...	16	1	17
	Ribston Pippin	...	...	...	...	...	6	6
	Charles Eyre	8	...	10	7		20
	Syke House Russet	...	...	...	...	...	6	6
	Spring Ribston Pippin	...	...	...	8	...	...	8
	Mr. Gladstone	6	5		11
	Golden Spire	14	9	...		23
	Rosemary Russet	6	6		12

Sector of fruit trees.	Variety.	Planted 1914-17.					Planted 1913.	Total number.	Description.	
		Upper garden.								
		Top block.	South block.	East block.	North block.	East extension.				Lower garden.
1	2	3	4	5	6	7	8	9	10	
Apple trees	Early Peach	...	...	10	...	...	...	10	Bush.
	Newtown Pippin	...	...	2	8	...	...	10	
	American Mother	...	...	0	...	...	...	9	
	Encore	...	...	...	18	...	...	22	
	Irish Peach	...	...	6	...	...	...	6	
	Lord Stradbroke	6	...		6
	Total	...	312	237	816	142	559	434	2399	
	Encore	6	6	Standards.
	Crimson Bramley	...	...	5	4	10	...	...	19
	Rymer	...	...	...	...	...	...	8	8
	Bramley's Seedling	...	...	...	8	12	...	...	20
	Court of Wick	...	...	...	6	...	...	...	6
	Irish Peach	...	...	...	...	6	...	...	6
	Northern Greening	...	...	...	...	...	...	8	8
	Norfolk Beefing	...	...	...	...	6	...	...	6
	Newton Wonder	...	...	4	21	...	...	...	25
	Stirling Castle	...	...	...	5	1	...	5	11
	Allington Pippin	...	...	...	...	...	...	4	4
	Annie Elizabeth	...	...	...	...	...	9	...	9
	Ellison's Orange	...	...	...	...	...	6	...	6
	Chelmsford Wonder	...	...	...	...	...	6	...	6
	Lord Grosvenor	...	...	...	...	...	7	...	7
	Christmas Pearmain	...	...	...	...	...	10	...	10
	Baldwin	...	...	1	...	...	...	...	1
	Duchess of Oldenburg	...	...	...	6	...	...	...	6
	Norfolk Bearer	...	...	...	5	1	...	...	6
	King of Tompkins County.	...	...	...	6	...	...	...	6
	Emperor Alexander	...	...	...	...	6	...	...	6
	James Grieve	...	...	3	18	...	...	...	21
	Cox's Pomona	...	...	...	2	4	...	...	6
	Small's Admirable	...	...	...	6	...	...	...	6
	New Hawthorden	...	...	...	5	...	...	...	5

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1913.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	East extension.			
1	2	3	4	5	6	7	8	9	10
Apple trees	Delicious (Starks)	...	50	12	62	Standards.
	King David	...	26	12	...	...	...	38
	York Imperial	...	...	6	...	...	...	6
	Paragon Winesap (Starks).	...	...	5	...	...	...	5
	Jonathan (Starks)	...	2	6	...	...	...	8
	Black Ben (,)	...	20	5	...	...	...	25
	Stayman Winesap (Starks).	...	...	6	...	...	...	6
	Senator (Starks)	...	1	5	...	...	...	6
	Grimes Golden (Starks)	...	12	5	...	...	...	17
	Summer Champion (Starks).	...	2	...	...	...	...	2
	Mother Starks)	...	...	6	...	...	...	6
	Emmuth Early	...	...	10	...	...	...	10
	Baumann's Reinette	...	...	10	...	...	...	10
	Greenspider	...	...	8	...	...	...	8
	Cor's Orange Pippin	...	...	15	...	...	...	15
	Blenheim Orange	...	3	9	...	...	...	12
	Calville Blanc	...	...	8	...	...	...	8
	Norfolk Beauty	...	15	13	1	...	1	20	
	Reinette du Canada	...	6	...	...	...	...	6
	Winter Greening	...	8	...	...	...	...	8
	Rev. W. Wilks	...	1	...	...	20	7	27
	Lord Burghley	...	6	...	...	...	...	6
	Lady Henniker	...	4	6	...	...	...	10
	Golden Spire	...	4	4	...	...	...	8
	Bismarck	...	4	6	...	...	...	10
	Calville Rouge d'hiver	...	...	...	...	...	1	1
	Charles Ross	...	3	2	...	4	...	9	
	Lord Derby	...	...	...	...	...	8	8
	Barnack Beauty	...	...	...	...	6	4	10
	Herrings Pippin	...	3	...	...	16	...	19
	Rival	...	2	...	...	6	...	8
	Star of Devon	...	...	...	...	4	...	4
	William Crump	...	...	...	...	5	...	5
	Epton Pyne	...	...	...	...	15	...	15

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1918.	Total number.	Description.	
		Upper garden.								
		Top block.	South block.	East block.	North block.	East extension.	Lower garden.			
1	2	3	4	5	6	7	8	9	10	
Apple trees ...	Early Melon (Starks)...	4	4	Standards.	
	Wealthy ( " )...	...	...	4	...	...	...	4
	Wilson's Red June (Starks).	...	...	6	...	...	...	6
	Liveland Raspberry (Starks).	...	...	6	...	...	...	6
	Worcester Pearmain ...	...	...	...	...	...	4	4
	Total	191	269	47	124	40	680	
	Elenheim Orange	2	11	13	Horizontal trained.	
	James Grieve	...	...	...	...	...	4	4
	Feltham Beauty	...	...	2	3	...	...	5
	Lady Sudeley	...	2	...	...	...	3	5
	Herring's Pippin	...	...	2	1	...	2	5
	Gaseoyne's Scarlet	...	3	...	...	...	...	3
	Charles Ross	...	3	...	...	...	...	3
	Brownlee's Russet	...	3	...	...	...	2	5
	Baumann's Reinette...	...	3	...	...	...	...	3
	Beauty of Bath	...	...	...	...	...	5	5
	Sturmer Pippin	...	6	...	...	...	...	6
	Cox's Orange Pippin...	...	...	...	...	...	1	1
	Cox's Pomona	...	1	...	...	...	3	4
	King of the Pippins	...	...	3	...	...	2	5
	Kerry Pippin	...	...	...	...	...	1	1
	Claygate Pearmain	...	...	...	...	...	1	1
	King of Tompkins County.	...	...	3	...	...	...	3
	Sterling Castle	...	...	...	...	...	3	3
	Total	...	21	...	18	15	...	27	75	
	Sturmer Pippin	3	3	Upright trained.	
	Mannington Pearmain	...	...	...	3	...	...	3
	Scarlet Golden Pippin	...	...	...	...	...	2	2
	Washington	...	2	...	2	2	...	6		

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1918.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	East extension.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Allington Pippin	2	2	Upright trained.
	Golden Spire ...	...	...	...	1	...	...	1
	Beauty of Bath ...	...	...	...	...	...	2	2
	Adams Pearmain ...	2	...	...	1	...	...	3
	James Grieve ...	...	...	...	...	...	3	2
	King of the Pippins...	...	...	2	1	...	...	3
	Barnack Beauty ...	...	...	...	...	...	2	2
	King of Tompkins County.	...	...	...	6	...	...	6
	Total ...	4	...	5	16	...	10	35	
	Charles Ross	6	6	Palmette Verrier trained.
	Rival ...	...	...	...	5	...	...	5
	James Grieve ...	...	...	...	6	...	...	6
	Blenheim Orange ...	...	...	...	6	...	...	6
	Total ...	...	...	...	23	...	...	23
	Baumann's Reinette...	4	4	Fan trained.
	Golden Spire ...	1	...	...	...	...	...	1
	Total ...	5	...	...	...	...	...	5
	Rival	3	3	Double Cordon.
	Total ...	...	...	...	3	...	...	3
	Rival	3	3	Single Cordon.
	Total ...	...	...	...	3	...	...	3

Species of fruit trees.	Variety.	Planted 1914-17.				Planted 1919.	Total number.	Description.
		Upper garden.				Lower garden.		
		Top block.	West block.	South block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees.	Fertility	53	13	71	Bush and Pyramid.
	St. Swithins ...	...	...	...	...	10	10
	Bearrs Hardy ...	...	17	...	3	...	20
	Red October ...	...	...	...	...	9	9
	Beurre d'Anjou ...	...	6	...	...	...	6
	Parrot ...	...	...	...	...	10	10
	William's Bon Christian.	...	13	...	...	...	13
	Seedling Bergamot ...	...	...	...	...	6	6
	Fondante Thiriot ...	...	10	...	...	10	20
	Dr. Hogg ...	...	...	...	...	7	7
	Triomphe de Vienne ...	...	6	...	...	...	6
	Beacon ...	...	...	...	...	7	7
	Beurre de Nagan ...	...	...	...	...	6	6
	Charles Ernest ...	...	12	...	...	...	12
	Roosevelt ...	...	...	...	...	6	6
	Doyenne d'Ete ...	...	10	...	...	...	10
	Blicking ...	...	...	...	...	6	6
	Ganeels Bergamot ...	...	6	...	...	...	6
	Santa Claus ...	...	...	...	...	6	6
	Josephine de Malines...	...	6	...	...	9	15
	Precoc de Juillet ...	...	...	...	...	5	5
	Dr. Jules Guyot ...	...	11	...	...	6	17
	Madame Treve ...	...	...	...	...	10	10
	Darondeau ...	...	7	...	...	5	10
	Hessle ...	...	5	...	1	13	19
	Beurre d'Amanlis ...	...	12	...	...	10	22
	Emile d'Heyet ...	...	5	...	...	10	15
	Marie Benoist ...	...	6	...	...	...	6
	Clapp's Favourite ...	...	5	...	...	10	15
	Louise Bonne of Jersey.	...	2	...	...	...	2
	President Barabe ...	...	5	...	...	...	5
	Thompson ...	...	5	...	...	...	5
	Winter Nells ...	...	4	...	...	...	4
	Marguerite Marillat...	...	6	...	...	...	6
	Sockle ...	...	...	...	6	...	6
	Beurre Fouquerey ...	...	...	...	6	...	6

Species of fruit trees.	Variety.	Planted 1914-17.				Planted 1918.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	South block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Directeur Hardy	5	5	Bush and Pyramid.
	Colmar d'Ete ...	...	6	6	...	...	12
	Princess ...	...	6	6	...	...	12
	Belle Julie ...	...	6	6	...	...	12
	Doyenne du Comice ...	...	2	4	...	...	6
	Total	232	39	4	177	452	
	Beurre Hardy	14	5	19	Single Cordon.
	Clapp's Favourite ...	...	10	...	...	...	10
	Durondeau ...	...	8	...	...	...	8
	Madame Freyre ...	...	10	5	...	...	15
	William's Bon Chretien ...	...	9	...	...	5	14
	Marguerite Marillat ...	...	12	...	...	5	17
	Doyenne du Comice ...	...	10	...	...	5	15
	Fondante Thirriot ...	...	...	5	...	...	5
	Louise Bonne of Jersey ...	...	10	...	...	3	13
	Conference ...	...	9	...	...	5	14
	Emile d'Heyst ...	...	9	...	...	...	9
	Winter Nells ...	...	5	...	...	...	5
	Fondante d'Automne ...	...	...	5	...	...	5
	Beurre Superfin ...	...	...	...	...	5	5
	Princess ...	...	...	5	...	5	10
	Beurre Fouqueray ...	...	...	5	...	...	5
	Beurre Diel ...	...	...	...	...	5	5
	Directeur Hardy ...	...	...	5	...	...	5
	Beurre d'Anjou ...	...	...	...	...	5	5
	Colmar d'Ete ...	...	...	5	...	...	5
	Total	106	35	...	48	189	
	Directeur Hardy	11	11	Horizontal trained.
	Duchess d'Angouleme ...	...	1	...	...	...	1
	Clapp's Favourite ...	...	2	...	...	...	2
	Josephine de Malines ...	...	1	...	...	...	1
	Emile d'Heyst ...	...	2	...	...	...	2
	Louise Bonne of Jersey ...	...	1	...	...	...	1

Poles of plant trees.	Variety.	Planted 1914-17.					Planted 1919.	Total number.	Description.
		Upper garden.							
		Top block.	West block.	South block.	Lower garden.	Lower garden.			
1	2	3	4	5	6	7	8	9	
	Beurre Superfin	1	1	Horizontal trained.	
	Princess ...	...	6	...	...	...	6
	Conference ...	...	2	...	...	...	2
	Dr. Jules Guyot ...	...	2	...	...	...	2
	Durondeau ...	...	1	...	...	...	1
	Pitmaston Duchess ...	...	1	...	...	...	1
	Fondante d'Automne...	...	1	...	...	...	1
	Doyenne du Comice ...	...	2	...	...	...	2
	Winter Nellis ...	4	...	...	...	...	4
	Marguerite Marillat ...	...	5	...	...	...	5
	Total ...	4	29	...	...	...	42
Arbrees	Marguerite Marillat	6	6	Standard.	
	King Karl (Starks) ...	...	1	...	...	...	1
	Anjou ( „ ) ...	...	3	...	...	...	3
	Lincoln ( „ ) ...	...	3	...	...	...	3
	Howell ( „ ) ...	...	6	...	...	...	6
	Duchess ( „ ) ...	...	3	...	...	...	3
	Bartlett ( „ ) ...	...	8	...	...	...	8
	Seckle ( „ ) ...	...	4	...	...	...	4
	Marie Louise ...	...	2	...	...	...	2
	Dr. Jules Guyot ...	...	5	11	...	...	16
	Conference ...	...	2	...	...	...	2
	Emile d'Heyst ...	...	3	...	...	...	3
	Madame Treve ...	...	8	...	...	...	8
	Count de Lamy ...	...	3	...	...	...	3
	Louise Bonne of Jersey ...	...	2	...	...	...	2
	Beurre Capinumont ...	...	6	...	...	...	6
	Princess ...	...	2	...	...	...	2
	Doyenne du Comice ...	...	2	...	...	...	2
William's Bon Chretien ...	...	2	...	...	...	2	
Souvenir du Congress...	...	2	...	...	...	2	
Marie-Louise d'Uccle...	...	2	...	...	...	2	
Family ...	...	2	5	...	...	25	
Seckle ...	...	...	...	...	...	...	...
	Total ...	...	97	24	...	...	12

Species of fruit trees.	Variety.	Planted 1914-17.				Planted 1913.	Total number.	Notes.
		Upper garden.						
		Top block.	West block.	East block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Princess ...	...	5	...	...	...	6	
	Conference ...	...	...	...	...	3	3	
	Madame Treve ...	...	...	5	...	...	5	
	Marie Louise d'Uccle ...	...	...	...	...	4	4	
	Louise Bonne of Jersey ...	...	...	...	...	4	4	
	Beurre Hardy ...	5	...	...	...	...	5	
	Fondante d'Automne...	...	...	...	...	3	3	
	Winter Nellis ...	...	...	...	4	...	4	
	Conseiller de la Cour...	...	...	...	...	3	3	
	Doyenne du Comice ...	...	...	...	...	3	3	
	Marguerite Marillat...	4	2	...	...	...	6	
	Total ...	9	7	5	4	20	45	

No. of fruit trees.	Variety.	Planted 1914-17.					Planted 1913.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.			
1	2	3	4	5	6	7	8	9	10
trees	Late Transparent	6	...	6	Bush.
	Deniston's Superb Gage.	...	...	...	...	...	19	19
	Satsurva ...	...	...	...	...	1	...	1
	Prosperity...	...	...	2	...	...	...	2
	Belle de Louvain ...	...	...	...	...	...	6	6
	Utility ...	...	...	2	...	...	...	2
	Greengage...	...	...	...	...	6	...	6
	Heron ...	...	...	5	...	...	...	5
	Monarch ...	...	...	...	3	...	...	3
	Stark's Gold ...	...	3	...	...	...	...	3
	Belgian Purple ...	...	...	...	...	...	10	10
	Ruth's Plumcot ...	...	1	...	...	...	...	1
	Pond's Seedling ...	...	...	...	...	3	...	3
	Stark's Shiro ...	...	1	...	...	...	...	1
	Stark's Omaha ...	...	...	...	1	...	...	1
	Autumn Beauty ...	...	...	...	1	...	...	1
	King of the Damsons ...	...	...	...	...	2	...	2
	Shepherd's Ballace ...	...	...	...	...	3	...	3
	Langley's Ballace ...	...	...	...	...	2	...	2
	White Damson ...	...	...	...	...	3	...	3
	Prince Sharp-shire ...	...	...	...	...	3	...	3
	Merryweather Damson ...	...	...	...	...	6	...	6
	Stark's America ...	...	...	...	2	...	...	2
	Burbank's Giant Prune ...	...	...	2	...	...	4	6
	Total		...	5	11	7	...	37		30	90
Decaise	1	...	1
Kirkos	2	...	2
Jefferson	2	...	2
Mallard	1	...	1
Golden Espereen	1	...	1

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1918.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.			
1	2	3	4	5	6	7	8	9	10
Plum trees	Gabin's Golden Gage	2	...	2	Fan trained.
	Reine Claude d'Alphon.	...	...	...	...	1	...	1
	Early Transparent	...	...	...	...	1	...	1
	Coe's Golden Drop	...	...	...	...	1	...	1
	Transparent Gage	...	...	...	...	1	...	1
	Georgage	...	...	...	...	2	...	2
	Golden Transparent Gage	...	...	...	...	1	...	1
	Belgian Purple	...	...	...	...	1	...	1
	Total	17	...	17	
Cherry trees	Mondino	3	3	...	6	Trees.
	Norfolk	...	...	...	...	...	16	16
	Egare de Norfolk	...	...	...	...	...	6	6
	Glaire de France	...	...	...	...	...	6	6
	White Heart	...	...	...	...	...	4	4
	Black Heart	...	...	...	...	...	5	5
	Kashmir	...	...	22	...	...	...	22
	Montmorency King	...	1	...	...	1	...	2
	Borland	...	...	4	...	...	1	5
		Total	...	27	...	3	5	26		71
	Turkey Black Heart	1	...	1	Fan trained.
	Late Black Heart	...	...	...	...	1	...	1
	Progenie Elvira	...	...	...	...	1	...	1
	Noir de Galen	...	...	...	...	1	...	1
	Pelle de St. Tron	...	...	...	...	1	...	1
	Early Rivers	...	...	...	...	1	...	1
	Total	6	...	6	

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1919.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Orange trees ...	Japanese Satsuma	1	1	...	2	Trees.
	Japanese Kumquat ...	...	8	...	...	4	...	12
	Malta Blood ...	...	4	...	...	...	2	6
	St. Michael's ...	...	1	...	...	1	...	2
	Jaffa ...	...	2	...	...	1	...	3
	Malta Oral ...	...	2	...	...	1	...	3
	Silver ...	...	3	...	...	...	1	4
	Excelsior ...	...	1	...	...	1	...	2
	St. Michael's Tangierin.	...	1	...	...	...	5	6
	St. Michael's Dom Louise.	...	1	...	...	2	...	3
Lemon trees ...	St. Michael's Sustain	...	1	...	...	...	1	2
	Ditto Achilles	...	...	...	...	...	1	1
	Total	...	25	...	...	11	10	46
	Imperial Lemon	...	...	...	...	...	2	2
Walnut trees ...	Bijou ..	...	...	...	...	4	...	4
	Total	...	...	...	...	4	2	6
	Dwarf Fro-life	...	7	...	...	...	10	17
Peach trees ...	Total	...	7	...	...	...	10	17
	Princess of Wales	...	...	...	3	...	...	3
	Peregrine ..	...	...	...	...	3	13	16
	Alexander...	...	...	...	...	3	10	13
	Duke of York	...	...	...	...	1	16	17
	Exquisite ...	...	...	...	...	...	2	2
	Late Devonian	...	...	...	...	2	...	2
	Lady Palmerston	...	...	...	...	2	...	2
	Kestrel ...	...	...	...	...	6	...	6
	Hales Early	...	...	...	...	3	...	3
Total	Total	...	...	...	3	20	41	64

Species of fruit trees.	Variety.	Planted 1914-17.					Planted 1913.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.			
1	2	3	4	5	6	7	8	9	10
Apricot trees ...	Superb (Starks) ...	...	...	...	...	1	...	1	
	Blenheim ...	...	...	...	...	6	...	6	
	Total	...	...	...	...	7	...	7	
Fig trees ...	White Marseilles ...	...	...	...	...	...	3	3	Trees.
	Bourjassotte Grise ...	...	...	...	...	...	3	3	
	Monaco Bianco ...	...	...	...	...	...	3	3	
	Total	...	...	...	...	...	9	9	
Quince trees...	Weiss Prolific ...	...	...	1	...	...	1	...	2
	Champion...	...	...	1	...	...	...	...	1
	Portugal ...	...	...	1	...	...	1	...	2
	Total	...	...	3	...	...	2	...	5
Almond trees ...	Hill Almond ...	...	...	12	...	...	...	...	12
	Total	...	...	12	...	...	...	...	12

Species of fruit trees.	Variety.	Planted 1914-17.				Planted 1918.	Total number.	Description.
		Upper garden.						
		Top block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Wineberry	6	...	6	Berries.
Lowberry ...	.....	...	...	...	...	6	6
Rubus Crataegifolius ...	.....	...	...	...	5	...	5
King's Acre Berry ...	.....	...	...	...	5	...	5
Loganberry...	.....	...	...	...	3	1	4
Phenomenal ...	.....	...	...	...	3	1	4
Laxtonberry ...	.....	...	...	...	3	...	3
Blackberry...	Flowers	100	...	100	Berries.
Ditto ...	Pyne's Giant Himalaya Berry of California.	...	...	...	100	...	100
	Total ...	...	...	...	225	8	233
Raspberry...	Pyne's Royal ...	20	20	Berries.
	Park Lane ...	...	...	...	20	...	20
	November Abundance ...	...	...	...	20	...	30
	Pyne's Devon ...	...	...	...	6	...	6
	Burgard's Goldendrop ...	9	...	...	...	...	9
	Total ...	20	56	...	85	Plants.
Strawberry	Givon's late Prolific...	...	...	...	900	...	900
	Louis Gauthier ...	...	500	...	350	...	850
	Royal Sovereign ...	...	3,000	...	1,250	...	4,250
	Laxton's Cropper ...	...	...	...	400	...	400
	Total ...	...	3,500	...	2,900	...	6,400
Currant ...	Boskoop Giant Black	3	2	Bushes.
	Defender Black ...	...	1	...	...	...	1
	Southwell's Black ...	...	20	...	20	...	40
	Total ...	...	23	...	21	...	47

Species of fruit trees.	Variety.	Planted 1914-17.				Planted 1913.	Total on abor.	Description.
		Upper garden.						
		Top block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Nat trees...	White Filbert	2	...	2	Trees
	Red Filbert	...	...	...	3	...	3
	Prize Cob	...	...	...	3	...	3
	Kentish Cob	...	...	...	3	...	3
	Total	11	...	11	
Grape Vines	Campbell's Early (Starks).	...	2	2	Vines.
	Hicks (Starks)	...	3	...	...	...	3
	King (,,)	...	2	...	...	...	2
	Eclipse (,,)	...	2	...	...	...	2
	King Philip(,,)	...	2	...	...	...	2
	Willer (,,)	...	2	...	...	...	2
	Worden (,,)	...	2	...	...	...	2
	Ningara (,,)	...	2	...	...	...	2
Total	...	17	...	...	...	17	

Summary of Fruit Trees planted to 30th June 1917.

	1913.	1914-17.	Total.
1	2	3	4
Bush Apple trees	434	1,896	2,330
Standard " "	49	631	680
Horizontal trained Apple trees ...	27	48	75
Upright " " " ...	10	25	35
Palmette Verrier " " " ...	...	23	23
Fan " " " ...	...	5	5
Double Cordon " " " ...	...	3	3
Single " " " ...	...	3	3
Bush and Pyramid Pear " ...	177	275	452
Single Cordon " " ...	48	141	189
Horizontal trained " " ...	...	43	43
Standard " " ...	...	121	121
Upright trained " " ...	20	25	45
Bush Plum trees	30	60	90
Fan trained Plum trees ... ..	...	17	17
Cherry standard trees	36	35	71
Cherry fan trained trees ... ..	...	6	6
Orange trees	10	36	46
Lemon "	2	4	6
Walnut "	10	7	17
Peach "	41	23	64
Apricot " ... ..	...	7	7
Fig "	9	...	9
Wineberry... ..	...	6	6
Lowberry	6	...	6
Rubus Crataegifolius ... ..	...	5	5

	1913.	1914-17.	Total
1	2	3	4
Loganberry ...	1	3	
King's Acre Berry	5	
Phenomenal „ ...	1	3	
Laxtonberry „	3	
Giant Himalaya Blackberry	100	
Blower's Blackberry	100	
Raspberry...	85	
Strawberry plants	6,400	
Currant Bushes	47	
Almond trees	12	
Nut - „	11	
Quince „	5	
Grape Vines	17	

C. H. HOLDER,

*In charge, Fruit Experiment
Station, Shilling*

The 24th August 1917.

Statement showing the Receipts and Expenditure of the Fruit Experiment Station, Shillong, from 1st July 1916 to 30th June 1917.

Receipts.	Amount.	Expenditure.	Amount.
1	2	3	4
	Rs. a. p.		Rs. a. p.
Proceeds of Apples ...	100 4 0	Allowance to Superintendent	3,000 0 0
" of Peaches ...	3 0 0	Establishment ...	2,340 0 0
" of Strawberries	140 8 0	Petty construction ...	633 13 7
" of Strawberry plants.	79 0 0	Seeds, Plants and Manures	1,916 14 11
		Instruments, appliances and machinery.	33 15 0
		Wages of labourers ...	5,974 8 0
		Service postage ...	15 0 0
		Other charges ...	411 15 3
Total Receipts ...	322 12 0	Total Expenditure ...	14,324 13 9

ANNUAL REPORT OF THE KARIMGANJ AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1917.

This station was established in January 1914. It is situated on the Sylhet road, $3\frac{1}{2}$ miles to the west of the subdivisional station of Karimganj which lies on the Assam-Bengal Railway.

The total area of the farm is a little under 80 acres. Leaving out a compact block of 8 acres which has been set apart for the farmstead and quarters for the staff, and the area covered by roads and drains, the net area available for cultivation is about 68 acres.

The station is devoted mainly to experimental work on rice and jute.

2. The farm lies close to the Langai river which occasionally rises in high flood and lays the country all round under water. This liability to floods is characteristic of the rice-lands in the locality.

The soil of the greater portion of the farm is a deep alluvial clay of fine texture, though not particularly heavy. In the higher lands, it is somewhat lighter in character and may be described as a medium loam.

3. During the year a new building was erected to provide much needed accommodation for the increased number of farm apprentices now being entertained. This is a *kutcha* building erected at a cost of Rs. 200 and will provide accommodation for eight additional men.

Owing to the increase in the number of varieties of rice under experiment, the existing godown accommodation was found insufficient. In order to increase the storage space a special granary division was made in the godown at a cost of Rs. 180, and an extension was added to the barn at a cost of Rs. 100.

The only work of reclamation undertaken during the year was the digging of a jute steeping pond at a cost of Rs. 100.

A long drain, leading from the south-east corner of the farm to a *khai* near by, was dug during the previous year for the purpose of draining the residential area; in former years this area was liable to be converted into a swamp during the rainy season.

It was subsequently found that when the water rose in the Langai river during high flood, there was a back-flow up the abovementioned *khal* or stream and along this drain. It was, therefore, decided to erect a small sluice gate with the object of preventing such back-flow of river water into the farm lands.

The work was carried out in the cold weather of 1916-17 at a cost of slightly under Rs. 100 and should prove beneficial. Fortunately, however, we had no floods to test the efficacy of the new sluice gate up to date.

The total number of cattle remains at 30 as at the close of the previous year. In July 1916 the farm stock suffered from an outbreak of foot-and-mouth disease, and fifteen head were affected more or less seriously.

The local Veterinary Assistant attended regularly and the farm staff co-operated whole heartedly in carrying out his instructions, with the result that every beast recovered without the slightest blemish.

The work of the farm was well in advance at the time of this outbreak and, as the healthy cattle were kept moving briskly, the farm work did not suffer any serious delay.

One bullock died from anthrax in February 1917, and a new one was purchased at a cost of Rs. 32 to take his place.

The other bullocks were inoculated immediately and no further cases occurred.

4. The official agricultural year is found extremely inconvenient for the purpose of report. It covers the latter half of one *khariif* season and first half of the *khariif* season following, and includes, of course, the *rabi* season intervening.

The following table shows the rainfall during each of these periods :—

					Actual.	Normal.
1					2	3
<i>Last half of khariif, 1916.</i>						
July	1916	...	..	...	41.61	23.11
August	"	...	...	...	20.46	22.83
September	"	...	...	...	13.94	18.58
October	"	...	...	...	14.01	8.31
Total					90.02	72.83

				Actual.	Normal.
1				2	3
<i>Rabi, 1916-17.</i>					
November 1916	...	...	...	1.09	1.31
December "	...	...	...	...	0.56
January 1917	...	...	...	0.12	0.75
February "	...	...	...	7.34	1.46
Total				8.55	4.08
<i>First-half of kharif, 1917.</i>					
March 1917	...	...	...	0.64	8.80
April "	...	...	...	13.28	18.72
May "	...	...	...	13.56	21.19
June "	...	...	...	25.76	31.45
Total				53.24	80.16
Total for the year...				152.71	157.07

The *kharif* season of 1916 was a most promising one and the prospect of a bountiful harvest continued until October.

In that month, however, excessive rainfall occurred in the hills which rapidly filled the rivers with an unprecedented volume of water. This was accompanied by what, under ordinary circumstances, would have been looked upon as a comparatively slight excess of local rainfall and resulted in a flood even more injurious than that of the previous year.

The actual damage to the crops on the farm, while considerable, was not so great as that produced by the 1915 floods, but, owing to the late season at which the damage occurred, was the cause of greater loss, seeing that it was then too late to replant the rice crop as had been successfully done in the previous year.

Most of the experiments in progress at the farm were so much injured as to yield comparatively valueless results, although a crop about 40 per cent. below the average was obtained.

The early months of the *rabi* season were much drier than usual, the excessive rainfall of February was too late to be of use and the result was that cold-weather crops on the farm only yielded a small return in the majority of cases.

The present *khari* season started unfortunately with a drought in the month of March, which delayed cultivation for the early paddy crop. During the next three months the rainfall was evenly distributed but somewhat lighter than the average for that period.

The farm crops are now doing well and the outturns from the present appearances are likely to prove satisfactory. The only exception is a portion of the early jute crop which was severely checked by lack of moisture and by injury from hail in the young stages of growth.

5. As befits a station situated in such an extensive rice-growing district as the Surma Valley, attention is devoted mainly to effecting improvements in this staple.

Rice breeding.

Rice breeding experiments were arranged in 1914 after a consultation between Mr. A. G. Birt, Deputy Director of Agriculture, Rai Bahadur B. C. Basu, Special Officer for Agriculture, and Mr. G. P. Hector, Economic Botanist, Bengal. These experiments have been carried on since.

It was hoped to obtain definite results after three or four years work, but, owing to the unfortunate floods which have interfered with the continuity of the experiments, the work has been delayed and a further period of a year or two will be required before definite results can be expected.

Ordinary rice seed is usually found on examination to be a mixture of different types of unequal quality and productive power. Some of these types are pure, and, therefore, breed true; others are the products of natural crossing and split into types differing in character and are consequently unreliable. The types also differ in regard to their productive power and other characters.

The method of breeding followed on the farm starts by growing in the first season, from ordinary village seed, as many local varieties of rice of each class as we can procure, and in picking out from each as many distinct types as we can detect while the crop is still standing in the field, each type being represented by the ripe ears taken from a single plant.

The next step is to grow the various lots of seed thus obtained in small plots side by side, first with the object of testing which of these types are constant and therefore, pure, and which again split as the result of previous crossing, and, secondly, with the object of comparing the pure types in regard to yielding power

and other characters. Though the rice flower is normally self-fertilised, a certain amount of natural crossing is known to occur. A clear space of 3 to 6 feet around each plot is kept in order to minimise the risk of inter crossing between adjacent types.

The next and third step is to take the pure types and grow them a second or even a third time (which is to be the work of the third or fourth season) in order to confirm the results of the second season as to their respective merits.

In this way at the end of the third or fourth season, we should be able to fix upon one or more of these pure lines, as being more prolific and of better quality all round than the rest within their own class. The next and last step will be to propagate these selected pure lines on a field scale for the purpose of distributing the produce as seed.

The experiment was commenced in 1913-14 with four classes of rice, namely, (1) early *aus* rice, which is usually grown broadcast and of which two crops may be taken in the course of a year, (2) transplanted *aus*, (3) *sail* or winter rice, (4) *asra*, which comprises the comparatively short stemmed varieties of *amon* or swamp winter rice, and which is capable of being grown either broadcast or transplanted.

The floods of 1915 destroyed all work done up to that time with transplanted *aus*, *sail* and *asra*, and the selection work with regard to these classes had to be undertaken *de novo*. It was then decided to restrict the work for some years to come to (1) early *aus* which was spared by the 1915 floods and (3) *sail* transplanted winter rice which forms the most important class of rice grown in the country.

Below is noted the work done on these two classes of rice since the experiment started.

Early aus.—This class comprises three sub-classes of rice, *viz.* *murali*, *chengri* and *dumai*. These differ from each other in regard to the depth of water which they can stand during the latter stages of growth and the time they take from sowing to harvest. A total of 161 distinct types was obtained by the selection work done in 1914. Out of these, 61 were obtained early enough to permit of their being sown again in September of that year.

The resulting plants were examined as to purity and three types were rejected as unsuitable for further work. Early in 1915 these types were sown again but were destroyed by the July flood of that year. Fortunately, however, duplicate halves of the seed of 57 of these types had been kept in reserve, as a precaution

against the accidental loss of the stock, and with this seed the work was continued in that year. These 57 types of early *aus* were sown in September and reaped in December 1915, and as was to be expected, the yields varied within very wide limits. From the seed thus obtained three further series of plots were sown in May 1916, that year's crop being the third generation from the first selected types. Full records are kept of the dates of sowing, flowering, and harvesting of each type and of its yield of grain and straw. These particulars, together with a description of the characters of each type, are kept in a register of pure cultures on the farm. As was expected, the variations in yield among the plots of the third generation were considerable and not sufficiently in agreement with the yields obtained in the first two generations to enable a selection to be made.

A further set of one series was laid down in September 1916 with seeds from the early crop of that year. These plots were injured by the October floods to such an extent that comparative results could not be obtained although sufficient seeds of this—the fourth generation—were harvested, to enable the work to be continued in the present year. One of these types was obviously different from the other, and it has in consequence been discarded.

During the present year it is proposed to grow a further two generations of the remaining 53 types, and if no untoward accident occurs to affect the yields, it is hoped that definite information may be gathered as to which are the most desirable types.

Sail.—This is the most important class of rice in Assam. As the result of the work done in 1915, 580 types were separated and these had just been sown in seed beds when the great flood of July came and destroyed them all. For the purpose of making the primary selection of types for a fresh start, seeds of 148 varieties of this class of rice were then collected, mostly from different parts of the Sylhet district, a few being obtained from the Sibsagar district, and some being the produce of the farm itself. On receipt of these varieties of *sail*, each was described in detail and all particulars entered in the "Register of type selection of *sail* rice" kept on the farm.

The seeds of these 148 varieties were sown in June and transplanted towards the end of July 1916. Although the plots were injured by the October floods, sufficient plants remained to enable a representative type to be selected from each plot for the present year's work.

Four additional types have been included this year bringing the total up to 152.

All were sown towards the end of the year under report and are to be grown as pure line cultures this season.

A new line of selection—intra-varietal selection—was recommended by Mr. Hector, Economic Botanist of Bengal, and incorporated in the Cropping Programme for 1916. *Lati sail*, as representing one of the most productive varieties of *sail* rice, was selected as the basis for this work. The crop was damaged by flood, but the experiment is being continued in the present year.

The main points of the work are :—

- (1) To grow this productive variety of rice under favourable conditions.
- (2) To pick out at random a number of plants of one type and arrange them in the order of their productiveness, as shown by the weights or number of grains produced by each.
- (3) To preserve the seeds from each plant separately, and use them as pure lines and compare the yields obtained.

Minor experiments. 6. The experiments carried out on a small scale included the following :—

(1) *Bonemeal as manure for double crop rice land versus no manure.*—This experiment which was begun in 1915 was designed to give some information, firstly, as to whether or not bonemeal manuring will prove profitable on the Karimganj Farm and similar rice lands, and, secondly, as to the quantity of bonemeal which should be applied.

Bonemeal has been used at three different rates, viz. :—

- (a) At 247 pounds per acre applied in 1915 and no manure in 1916.
- (b) At 494 pounds per acre applied in 1915 and no manure in 1916.
- (c) At 247 pounds per acre in 1915 and 3 maunds per acre in 1916.

The first crop of 1915 and the second crop of 1916 were injured by floods and no results were available. The yields, as far

as they have been obtained for the two years, are shown in tabular form :—

	Yield per acre, in pounds.		
	1915 2nd crop.	1916 1st crop.	Average of two crops.
1	2	3	4
Bonemeal 247 pounds per acre, 1915, and no manure in 1916.	3,289	1,578	2,433
No manure	3,009	1,477	2,243
Bonemeal 494 pounds per acre, 1915, and no manure, 1916.	3,122	1,600	2,361
No manure	2,190	1,357	2,271
Bonemeal 247 pounds per acre, 1915, and 247 pounds per acre, 1916.	...	1,619	...
No manure ... ..	...	1,470	...

The disturbing effect of the floods makes this experiment of little value up to the present.

The average yields, however, indicate that a light application will be more profitable than a heavy application.

The question as to whether or not any application of bonemeal is likely to yield a profit on soil such as that of Karimganj Farm can only be decided by a continuation of the experiment.

(2) *Green manuring for the rice crop versus no manure.*—This experiment, started in 1915 with cowpea and *Dhaincha*, was continued in 1916 with slight modifications. Duplicate plots were treated with ground limestone at 823 pounds per acre in the past year, the average yields of paddy per acre being as follows :—

	Pounds.
<i>Dhaincha</i> alone	1,586
No manure	1,397
<i>Dhaincha</i> and 823 pounds ground limestone ...	1,469
No manure	1,251
Cowpea alone	1,294
No manure	1,251
Cowpea and 823 pounds ground limestone ...	1,691
No manure	1,397

The cowpea did not grow well and even on the limestone area it was very poor. *Dhaincha* gave a very successful crop and was specially good on the plot manured with ground limestone.

The *sail* paddy crop was slightly damaged in parts by the October floods and therefore the above figures are not absolutely comparative.

There would, however, seem to be no doubt of the benefit to the succeeding rice crop of a well grown leguminous crop.

(3) *A combined variety and manurial experiment on jute.*—As in 1915 three varieties were tested against one another, viz., a pure line bred by Mr. R. S. Finlow, Fibre Expert, Bengal, a local variety, and a variety obtained from the Goalpara district.

The average outturn of fibre in pounds per acre for the two years was as follows :—

	Mr. Finlow's.	Local variety.	Goalpara.
1	2	3	4
Yield per acre in 1915	2,033	1,224	1,733
Yield per acre in 1916	1,734	1,115	1,042
Average for two years	1,885	1,160	1,390

A fresh supply of seed was obtained last year of all three varieties and it would seem from the yield that the Goalpara lot was not so good as that obtained in the previous year.

The yields obtained from Mr. Finlow's variety leave no doubt of the great superiority of this selection to any of the ordinary varieties.

The manurial experiment consisted of a comparison of the yields of fibre obtained from (a) an unmanured area, (b) an area manured at the rate of $5\frac{1}{2}$ tons of cowdung per acre, (c) an area manured at the rate of $5\frac{1}{2}$ tons of cowdung and 247 pounds bone-meal per acre. The average results were :—

	No manure.	Cowdung.	Cowdung and bone-meal.
1	2	3	4
Yield per acre, in pounds	504	1,055	1,854

These results show in a very striking manner the benefits of manuring the jute crop on lands such as those of the Karimganj Farm. Although excellent results have followed from the use of bonemeal, it is not claimed that this is the most suitable class of manure for a crop like jute.

(4) *Jowar as fodder in the rains.*—*Jowar* was grown both as a rains crop and as a cold-weather crop. The seed for the rains crop was sown on slightly more than half an acre of land in May. Half of this land was manured with cowdung only, applied at the rate of $5\frac{1}{2}$ tons per acre. The other half received a similar quantity of cowdung, and in addition was dressed with ground limestone at 823 pounds per acre.

Cowdung alone gave a crop of green fodder weighing 5.2 tons per acre, while cowdung and ground limestone gave a crop of 7.7 tons per acre.

It was intended to keep some of this crop for seed. After the October floods there was no pasture available for the farm cattle and only a small quantity of old paddy straw. Accordingly all the *jowar* had to be used for feeding the farm cattle.

It was extremely fortunate that we had the *jowar* crop, as the thirty head of farm cattle were kept in first class condition for several weeks by its help. By the end of that time, *kalai* which had been sown immediately after the flood, was ready for grazing and supplied food for the cattle until there was again some grass and a further supply of paddy straw.

A larger area of *jowar* and of a mixture of *jowar* and cowpea is being grown this season to enable experiments to be carried out in the making of ensilage.

(5) *Mr. Hector's improved rices against country rices.*—As in 1915, Mr. Hector's selected rices, *Indrasail*, *Lambachikan* and *Kandulia*, were tested against two of the most productive local rices named *Latisail* and *Terabali*. This experiment was also injured by the floods, and consequently the yields are not absolutely comparative. However, they are now given as they seem to show that the Bengal rices which have proved so promising in their own country are likely to be of value under the somewhat similar conditions of the Surma Valley.

The average yields per acre of these plots which were least injured were :—

			Pounds.
<i>Terabali</i> (local variety)	...	...	1,401
<i>Indrasail</i> (Mr. Hector's)	...	...	1,534
<i>Kandulia</i> (Mr. Hector's)	...	...	1,606

All five varieties are being tested again this year in the hope that more decisive results will be obtained.

(6) *Improved varieties of sugarcane from the Jorhat Farm.*—The three varieties B 147, B 376 and Striped Mauritius were grown as a ratoon crop on a small scale and the sugarcane made into *gur*.

The farm lands are situated at too low a level for the successful growth of sugarcane on a large scale, but this small experiment was carried out with the object of giving the farm apprentices a knowledge of the cultivation of sugarcane and of the making of *gur*.

The yields of *gur* averaged practically the same for all three varieties, *viz.*, about 3,000 pounds per acre.

7. A large area of non-experimental rice was grown during the year. Together with the experimental rice, it covered almost the entire area of the cultivated portion of the farm, the balance being occupied by small areas of sugarcane and of jute and *dhaincha* which were grown for seed.

The total yield from the rice crop including the experimental *sail* rice was as follows :—

	Approximate area.	Total yield.	Yield per acre.
1	2	3	4
	Acres.	Tons.	Pounds.
Rice (<i>asra</i>)	27.25	15.32	1,260
Rice (<i>sail</i>)	23.00	8.22	805
Rice (experimental area— <i>sail</i>) ...	3.65	1.72	...
Total in 1916	53.90	25.26	1,051
Total in 1915	52.64	47.98	1,991

This very serious drop in crop outturn as compared with the previous year was due to the October floods.

Dhaincha was kept for seed on an area of .3 acres and gave an outturn of 325 pounds or at the rate of 1,084 pounds per acre.

8. In view of the series of disastrous floods which has been experienced in recent years it was felt that attention ought to be paid to cold-weather cropping. Accordingly in the cold-weather season

Cultivation of cold-
weather crops.

315-16 small plots of the following cold-weather crops were laid down :—*Jowar, kalai, khesari, musur, mung, gram, linseed, mustard, coriander, peas, wheat, oats, barley, radish*. Some of the pulse crops were sown on silt but, probably on account of the sticky nature of the silt and the fact that there was extremely little rain in the early part of the *rabi* season, the crop was poor in many of the plots.

The average yields per acre are now given :—

Crop.		Yield per acre, in pounds.	Remarks.
1	2	3	
wheat	423	Did not tiller.	
barley	612		
oats	1,357		
peas	706		
<i>rabi Jowar</i> ... ..	...	Was a small crop which was made into manure and fed to the farm cattle.	
radish	154		
mustard	116	Was injured by aphides. The best plot gave at the rate of 400 pounds per acre.	
linseed	565		
coriander	864		
<i>kalai</i>	216	The early sown crop was destroyed by the flood. Another part was sown very late and gave small outturn. The best crop, sown on silt, gave at the rate of 480 pounds per acre.	
<i>khesari</i>	218		The best results were obtained where the seed was sown on silt among the remaining paddy plants.
<i>musur</i>	103	Was a failure.	
<i>mung</i> ... ..	...	
<i>gram</i>	271		

Taken all over, the yields from cold-weather crops were small; this was no doubt largely due to the fact that the early part of the *rabi* season was excessively dry and these crops had in consequence a very unfavourable start. Notwithstanding the adverse conditions, oats and peas gave comparatively good yields.

Linseed was much the best of our oilseeds. Coriander seems a promising miscellaneous crop. The pulse crops, it must be admitted, were not successful as a whole, yet there are some crumbs of comfort to be extracted from the work. The fact that a crop of *kalai* yielding at the rate of 480 pounds per acre was grown on about half an acre of silt-covered land is suggestive of what might be done towards increasing food production in the cold-weather. The only outlay in this case was the cost of seed and of labour which would not, at the most, exceed Re. 1-8 per acre. *Khesari* sown similarly among the paddy stems gave about 240 pounds per acre. This, though small, would be a paying return considering the smallness of the outlay necessary.

9. Although different insect pests made their appearance at various times of the farm, no very serious damage resulted.

Insect pests.

The Farm Manager took timely steps to combat any pests of the kind. Hand picking, catching by light traps and by bag net, were variously resorted to and the result was that no damage of any consequence was suffered by the farm crops during the year, although many of the neighbouring crops suffered considerably.

In the early stages of the development of the hairy caterpillars the grubs are found clustered together on the leaves of the affected plants during the first few days after hatching out. At this stage much damage can be avoided by picking off the leaves bearing clusters of caterpillars and killing them in hot water or a little kerosine oil. This method was very successful in the case of the farm jute crop which was badly attacked last year.

Rice bugs (*Leptocorisa varicornis*) are the cause of immense damage to the rice crop each year and particularly to the early varieties. The most effective method we have found of checking the ravages of these insects, is to prepare a light cloth about fifteen feet long and four feet wide. Two boys use this by standing at opposite ends of the cloth, and with a corner in each hand they allow the middle to fall and bring up the sides until they are about 18 inches apart. One side of the bag net so formed, is allowed to sweep along the top of the affected crop, while the workers run quickly across and across the plot. At each end the bag net is closed and twisted to destroy the many bugs which are captured in this way.

The stem borer moth is attracted by any light during the night time and can be easily tempted to his undoing on this account. An ordinary hurricane lamp is suspended over a barrel or tub of water which has been covered with a light film of

kerosine oil. The moths flutter in large number round the lamp and most of them ultimately fall into the water and are killed by the kerosine. Where no large vessel is available, a small raised pond could be made with mud banks, filled with water and covered with a spoonful of kerosine, and a torch placed over it would provide sufficient attraction.

10. The receipts during the year amounted to Rs. 827-6 derived mostly from the sale of paddy. In addition there were balances of paddy, *kalai*, etc., at the end of the agricultural year worth approximately Rs. 1,510 making the total income for the year Rs. 2,337 as compared with Rs. 3,628 for the previous year.

The total expenditure was Rs. 7,294-2-11 which compares with Rs. 7,336-4 in the previous year. It was distributed as follows :—

	Rs.	a.	p.
Establishment	2,467	13	11
Petty construction, including fencing, roads, bridges, etc.	600	0	0
Purchase of machinery	25	0	0
Reclamation	204	8	9
Feed of cattle	345	7	2
Seeds, plants and manures	34	0	9
Wages of labourers	2,330	11	6
Petty repairs	541	4	1
Books, maps and periodicals	23	11	0
Service postage stamps and telegrams	50	0	0
Unspecified charges	534	12	3
Purchase of furniture	104	9	6
Purchase of cattle	32	4	0
Total	7,294	2	11

11. The sanctioned establishment of the farm consists of—

	Rs.
1 Farm Manager	100—5—200
1 Assistant Farm Manager	25—1-8—40 Plus
	Rs. 10
	local al-
	lowance.
1 Farm Clerk	25—1-8—40
1 Peon	8

In addition arrangements are made for the entertainment of apprentices, to be trained for eventual employment as Agricultural Demonstrators. The term of training extends to 2 years.

The first apprentice trained at the farm was appointed as Demonstrator in August 1915. During the year under report 3 young men completed their training and are now at work as Demonstrators. The vacant apprenticeships were immediately filled up and at the present time the full complement of six young men are under training. During the year the scheme of giving preliminary practical training to young men of the *Bhadra* class intended for scholarships at Sabour was inaugurated. These young men, who are given an opportunity of qualifying for posts as Agricultural Inspectors, are to be trained in practical agriculture for one year. Two were selected in the beginning of the year under report; one put in an appearance at the farm but left soon afterwards. The other, Babu Pulin Behari Ghosh, put in his trial period satisfactorily and has since been awarded a scholarship at Sabour. Two young men have been selected for the vacant apprenticeships and have joined at the farm shortly after the end of the year under report.

Babu Surendra Nath Gupta, who was in charge of the farm at the beginning of the year, has since August 1916 been confirmed in the appointment of Farm Manager.

Srijut Lalit Mohan Das, who held an appointment as Temporary Agricultural Officer and really acted as Assistant Farm Manager, was appointed Agricultural Inspector, Karimganj and Cachar, in August 1916, and Srijut Nabin Chandra Barua was then promoted from the post of Demonstrator in the Assam Valley to the post of Assistant Farm Manager which he still holds at the end of the year. Babu Nirod Behari Sarma held the post of Farm clerk throughout the year.

CAMP DHUBRI,

The 5th August 1917.

J. W. MCKAY,

Deputy Director of Agriculture,
Surma Valley and Hill District

ANNUAL REPORT OF THE KAMRUP SUGARCANE
EXPERIMENT STATION FOR THE YEAR ENDING
30TH JUNE 1917.

Introductory.—The objects and scope of this experiment were set out in paragraph 1 of the report for 1914.*(1)

For reasons explained there it was proposed to take up 1,000 acres more or less, reclaim it and grow cane on it. Unforeseen circumstances have delayed the full accomplishment of this scheme to-date. The area reclaimed and under cultivation at the present time is 12 blocks comprising 650 acres in all, of which some 500 acres are now under cane, plant and ratoon. The area under cultivation on 30th June 1916 was 375 acres, the remaining 275 acres having been reclaimed during the year under report.

Last year's report dealt with the crop planted, February—March 1916, and its cultivation and progress to 30th June 1916. The present report is concerned with the subsequent development of that crop, which was harvested, February—April 1917, and also with the operations appertaining to this the third year of experiment proper, covering the preparation of the land, planting the crop and its subsequent cultivation and behaviour to the end of June 1917.

2. *Land and communications.*—The site of the experiment is situated in North Kamrup under the Bhutan Hills, about 17, miles by road north of Nalbari station, Eastern Bengal Railway and lies between the new and old Pagladiya rivers and near the village of *Topolia*. The farm is approached from Nalbari station by a public road northward to Garbhitar village, some 10 miles, where a village track leading to Khagrabarigaon has been widened out and made into a carting road and extended to the present farm site which is 7 miles from Garbhitar. The greater portion of this tract consists of high land carrying tall grass jungle, with occasional swamps which are, however, capable of drainage, the fall from the hills to the south being from 15 to 20 feet per mile.

*(1) Annual Report of the Kamrup Sugarcane Experiment Station, year ending 30th June 1914.

3. *Rainfall*.—Farm records have been kept since January 1915; the following figures are for the Agricultural year ending June 30th, 1917:—

				Inches.
July 1916	...	...	...	14.03
August "	...	...	...	14.30
September "	...	...	...	10.34
October "	...	...	...	11.16
November "	...	...	...	nil.
December "	...	...	...	0.27
January 1917	...	...	...	nil.
February "	...	...	...	3.58
March "	...	...	...	1.20
April "	...	...	...	2.36
May "	...	...	...	8.48
June "	...	...	...	24.93
Total	...	...	...	90.65

The rainfall during 1916 was copious, total 101 inches, and well distributed, extending to the third week in October, when it suddenly ceased.

From the 1st January to the end of May 1917, which covers the important periods of planting, germination and early growth, the rainfall was very much less than for the corresponding months of the two previous years, and the young plant cane suffered somewhat in consequence. (*Vide* paragraph 13.)

4. *Soil*.—The soil of the high land varies from good loam to sandy loam on a sandy sub-soil. In few places, the sand comes to the surface, but usually there is from 1 to 3 feet of good soil, while in the swamps the soil is stiff, on a stiff sub-soil, although it is probable that sand exists at no great depth. Except on the few sandy patches the soil is dark brown or black in colour, denoting good supplies of organic matter. On the whole, the soil is a good loam, easily worked once reclaimed, and very suitable for cultivation. Moreover, the soil is well adapted to the climate; the annual rainfall being high and well distributed demands a light free draining soil such as exists here. Judging by the growth of the other crops, as well as sugarcane, the present fertility is high, and except on some of the lower lying parts, which before reclamation and drainage by us have probably been more or less swampy for generations, there is no evidence of any toxic factor; moreover, on these lower lying areas the toxic

factor apparently rapidly disappears under cultivation after drainage and heavy rain. The evidence of fertility as shown by the growth of many and diverse crops confirms some soil analyses made personally some 4 years ago on samples from an adjoining tract.

5. *Buildings, fencing, etc.*—The buildings consist of the Manager's bungalow, office with dispensary, coolie lines, cattle shed, godown, smithy, etc. The coolie lines were rebuilt during the year. Extension of the farm area necessitated the purchase of 2,000 yards wire fencing at a cost of Rs. 1,351, the whole farm being enclosed. It may be stated here that in spite of this, great destruction was caused in places by bears, though pig and deer, etc., were excluded by the fencing.

6. *Cattle.*—The 10 pairs of bullocks belonging to the Farm were reinforced by 31 pairs sent down by Mr. W. Maxwell, the cane contractor. These were steadily employed carting out machinery and plant for the factory, and during cane harvest.

An outbreak of rinderpest occurred early in 1917, and five pairs of bullocks died. At present, the remainder are in excellent condition.

7. *Water-supply.*—Norton tube wells are used with great success, and an excellent supply of drinking water is available all the year round. These wells distributed over the cane area, provide water also for the engines. In addition, a permanent running stream close by the coolie lines supplies water for washing purposes, etc.

8. *Labour.*—As much dependence cannot be placed on the local (Kachari) labour supply, most of our coolies are imported from Ranchi, being recruited personally by the Manager with the sanction of the Bihar and Orissa Government on a six monthly system. Many of these coolies settle down on the expiry of their term, and the system works quite satisfactorily. Speaking generally the labour force keeps very good health. A compounder was entertained during the year, and a dispensary started. No epidemics of a serious character have occurred heretofore. An epidemic of cholera in a village very near by carried off many of its inhabitants, but no cases at all occurred in our coolie lines, where well water only was used for drinking.

9. *Cultivating tackle.*—This comprises :

Two steam tractors compound engines, 1 five-furrow double ended plough, 1 harrow, 1 cultivator, 1 roller, 1 ridger, 1 leveller and 1 ditcher and a motor plough. Most of this tackle has now been in use for three seasons and is in excellent condition.

10. *Drainage scheme.*—The system of drainage adopted last year, outlined in paragraph 11 of the report for 1916, having proved so efficient, has been extended to the new area reclaimed, and is working quite satisfactorily. The water table has been considerably lowered in consequence, and the heaviest falls of rain are rapidly carried away, surface accumulations after such falls being now a thing of the past. The reclamation and drainage of new extension areas year by year undoubtedly improve the drainage of those areas previously reclaimed and put under cultivation, by dealing with water which heretofore used to flow in from surrounding unreclaimed land.

11. *Cane planted, February—March 1916.*—Refer to paragraphs 13 and 14 of last year's report. As therein shown some 280 acres of new cane were planted, making, with 40 acres of ratoons, a total of 270 acres under cane. The early growth of the crop, which was excellent, was described in paragraph 14 of last year's report, up to the end of June 1916. It remains to outline its subsequent progress. Well distributed rain continued up to the third week in October and the growth of the crop was all that could be desired up to that time. Some blocks continued to make growth into December, others ceasing growth and beginning to ripen off somewhat earlier, the operating factors being (a) variety, B-376 and Striped Mauritius ripening earlier than B-147, (b) whether ratoon or plant, ratoons ripening first, (c) the relative level of the land, ripening on lower lying areas being retarded. Ripening proceeded normally, Striped Mauritius and B-376 ratoons being quite ready for the mill early in January. (Had the factory been ready, milling of these two varieties could have been commenced in December.) Ratoon B-147 was at that time not fully ripe. The plant cane ripened off in February and March.

Harvesting commenced on the 15th February and continued intermittently until the middle of April. Cane was supplied under contract to Mr. W. Maxwell, being sold to him on a sliding scale based on its Sucrose content and the price obtained for the *gur*.

Mr. Maxwell had erected a *gur* factory on the farm for dealing with the crop. Owing to unavoidable delay in the arrival of the machinery and plant manufacture was commenced very late. In consequence of this and other difficulties, climatic and otherwise, the manufacture of *gur* on a large scale with open evaporators was carried on under great difficulties and was found to be impracticable. In the result only some 775 tons of cane was dealt with in the factory, the remainder of the crop being

thrown away or distributed for sets. This was regrettable, but in all the circumstances unavoidable. The *gur* factory is now being converted into a white sugar factory on modern lines, and it is intended to convert the crop now on the ground direct into white sugar next cold weather. It is only fair to Mr. Maxwell to say that it was delay in the completion of the contract which prevented more being accomplished last year, and which led to the temporary expedient of installing the *gur* factory to save the crop if possible.

Despite the utmost exertions and the best intentions this laudable ambition, in the event, proved unattainable.

Outturn and quality of cane.—It is much to be regretted that owing to the adverse circumstances under which harvest and manufacture were carried on this year, hampered as we were by the uncertain and intermittent demands of the factory, by the contemporary planting up of extension areas, and by the despatch of a very large number of cane sets from the farm (some 2½ lakhs of cuttings being sent out for sale and demonstration purposes), as also by the fact that the greater part of the crop had perforce to be cut and thrown away, it is quite impossible to say what the total crop was, as it proved out of the question to weigh it all. The whole of the cane entering the factory was weighed, but as this consisted largely of the bottom halves of canes of which the top parts were used for planting, the factory records are not of much assistance in estimating the crop yield.

The plant cane yielded the heaviest crops, the outturn being otherwise a function of variety, date of planting, relative level of the land, and the length of time which elapsed between reclaiming an area and planting it up.

From such limited records as are available, I am convinced we shall not be very wide of the mark in placing the average crop for the whole area under cane at about 20 tons per acre. The ratoon crop in places was as low as 15 tons per acre, while the plant cane varied from about 18 tons to as much as 30 tons in certain areas.

The ripening season was a good one, and the canes matured their juice perfectly. Analyses were made at various periods, some results of which appear in Table I.

TABLE I.

Date.	Variety.	Block No.	Brix at 17.3 degree centigrade.	Sucrose in juice.	Glucose in juice.	Glucose ratio for juice.	Purity co-efficient of juice.	Sucrose on cane.	Remarks.
1	2	3	4	5	6	7	8	9	10
January 10, 1917	Striped Mauritius ratoons	I	19.3	18.65	0.38	1.65	95.9	(15.4)	These ratoons were evidently ready for harvesting at this time, but were not milled till much later in the season, as the factory was not completed.
" 11, "	B-376 ratoons	II	18.3	17.46	0.29	1.17	85.4	(14.6)	
" 12, "	B-147 ratoons	I	18.6	17.22	0.47	2.73	92.3	(14.3)	
January 11, 1917	B-147 plant cane	II	18.7	14.47	1.19	8.27	86.5	(12.0)	The plant canes were not at all fully ripe at this time as at the figures show. B-376 and Striped Mauritius were much more ripe than the plant cane, and were quite ready for milling in January.
" 12, "	B-376 "	III	17.7	16.85	0.31	1.84	95.0	(14.0)	
" 13, "	Striped Mauritius plant cane.	III	18.1	17.0	0.43	2.11	94.0	(14.1)	
February 20, 1917	B-376 ratoons	I	19.0	17.42	0.55	3.2	91.6	(14.5)	These analyses were made on composite samples taken at the factory during the short working period. The figures for percentage of sucrose on cane were obtained from the analytical figures of the cane samples. The figures for percentage of 70 per cent. juice and 30 per cent. Bagasse, figures obtained by actual test at the factory mills.
" 21, "	B-376 and Striped Mauritius ratoons.	I	18.8	17.6	0.4	2.23	93.0	(14.0)	
March 8, "	Striped Mauritius and B-376.	I	19.3	18.49	..	..	95.6	15.4
" 9, "	B-147 plant cane	V	19.8	17.94	..	..	90.6	14.98
" 12, "	Striped Mauritius, B-147 plant.	I, IV and V	19.7	18.0	..	..	91.3	14.98
" 14, "	B-147 plant	I, IV and V	20.4	18.35	..	..	89.3	15.38

Note on Table I.—It is to be regretted that more analytical data could not be obtained this year. The circumstances were exceptional, as previously explained, and prevented more being done in this connection.

From the figures for analyses made early in January it will be seen that the ratoon canes of all these varieties were at that time of high quality and purity, B-147 being rather less ripe than Striped Mauritius or B-376.

Of the plant cane analysed at the same time, B-376 and Striped Mauritius were ready for milling, and using the conversion factor obtained later by actual test on large quantities of cane and juice, these varieties must at that time have contained at least 14 per cent. of Sucrose on cane. B-147 plant cane was much later than the other varieties in ripening. This is characteristic of that variety, and is of advantage in extending the milling season.

The tests made in February and March, for which figures are given, were carried out on large composite samples obtained at the factory during part of the working season.

The ratoon canes of B-376 and Striped Mauritius had become very slightly over ripe, but were still of high quality.

The plant canes of all three varieties had by early March matured their juice and were very rich in sucrose, averaging out 15 per cent. on cane. Both juice and Bagasse were analysed, and knowing the relative proportions of either derived from crushing a given weight of cane, the figures for sucrose on cane were accurately obtained. From these actual tests, the conversion factor 0.834 was arrived at as the figure by which the per cent. Sucrose in Juice must be multiplied to give per cent. sucrose on Cane.

Those figures for percentage of Sucrose on Cane which appear in brackets in the table, are the result of using this factor. Where the figures do not appear in brackets, they are the results of actual analyses made on both Juice as well as Bagasse.

12. *Extension area, Season, 1916-17.*—Reclamation commenced in the middle of October 1916, and went on into May 1917, the total new area brought under cultivation being 275 acres. In addition 90 acres of land reclaimed last year were reploughed, cultivated, harrowed, drained and trenched. The operations consisted of the harrowing down of grass jungle previous to burning off; ploughing, harrowing, cultivating twice followed by harrowing, draining and trenching for planting. The whole of the area was drained as per scheme described in paragraph 11 of last year's report, previous to planting.

13. *Planting of present crop.*—Planting commenced mid February and was finished by the end of March 1917. In all 260 acres new cane was planted, some 70 acres of this being on land reclaimed 12 months earlier, the remaining 190 acres newly reclaimed. The remaining newly reclaimed land is being kept under cultivation for planting in 1918. The total area under cane this year, plants and ratoon, amounts to just over 500 acres. Germination of the cane planted in February was good; the later planted areas suffered somewhat as a result of the drought which followed in March and April this year. Up to the end of April 1917, only 7 inches of rain was recorded this year against 18 inches in 1916 and 11.5 inches in 1915. Further, the rainfall in May was only 8 inches this year as against 23 and 21 inches in the two previous years.

In the result, on some parts of the newly reclaimed and planted areas, *i.e.*, the lower lying parts, the young plant crop is very thin. Since germination and early growth is very much better on the slightly higher and therefore drier parts of the same areas, the explanation would appear to be that these lower lying areas were, temporarily at any rate, somewhat toxic, and that being newly reclaimed and there having been no heavy rain since reclamation and drainage, the accumulated toxins had not been washed through into the drains and thereby eliminated. That this explanation is correct is suggested by the observed fact that if these lower lying areas are reclaimed, drained and cultivated 12 months prior to planting out, they carry much better crops of cane. Except on the above-noted areas the young crop is doing well to date, more especially where planted early and again on parts of two blocks Nos. V and VI which were reclaimed 12 months previous to planting out, No. VI having been meanwhile green-manured with *Dhaincha* last rains.

On the whole, the crop prospects are not so favourable as they were last year at this time.

The varieties of cane under cultivation are Striped Mauritius and Barbadoes 147 and 376.

14. *Cane Nursery—New Varieties for trial.*—The following varieties were grown in the nursery, (a) Red sport of Striped Mauritius; (b) Barbadoes 1529; (c) Barbadoes A and B (numbers uncertain); (d) B-6150; (e) B-3412; (f) Java 247; (g) Java 33a; (h) White Bombai.

Of these Barbadoes A, B-3412, B-6450 and Java 33a and White Bombai showed promise.

All the above, with the exception of B-1529, are being nursed again this year.

Seven other new varieties have been added this year, making a total of 15 new varieties under trial. They are as follows :—

W. M. Nos. 1; W. M. No. 2; W. M. No. 3; W. M. No. 4; B-208; White Tanna; Kamrup Red sport of Striped Mauritius.

The varieties showing most promise at present are White Bombai; W. M. Nos. 2, 3 and 4; B-208; the local Red sport of Striped Mauritius; J 33a; Barbadoes A; B-6450 and B-3412.

15. *Other crops*.—Dhaincha (*Sesbania Aculeata*) made a good green manure crop on Block VI, and was ploughed in by the steam tackle in August. It subsequently decomposed perfectly, there being some 21 inches of rain after ploughing in.

Small areas of Dhaincha and Cowpeas (*Vigna Catjang*) were grown for seed on newly reclaimed land. Competition with jungle was severe, and the yield of seed was in consequence small.

No other crops were grown.

Rains crop 1917—5 acres Daincha (*Sesbania Aculeata*) for seed.

16. *Expenditure* :—

From the 1st July 1916 to the 30th June 1917.

KAMRUP SUGARCANE FARM.

Head	From 1st July 1916 to 31st March 1917.	From 1st April 1917 to 30th June 1917.	Total.
1	2	3	4
ESTABLISHMENT.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Manager	7,200 0 0	2,400 0 0	9,600 0 0
Clerks	450 0 0	225 0 0	675 0 0
Componder ... ..	...	90 0 0	90 0 0
Peons	270 0 0	90 0 0	360 0 0
Tackle Assistants	1,770 10 3	615 2 0	2,385 12 3
Additional Establishment ... ..	...	135 0 0	135 0 0
Total	9,690 10 3	3,555 2 0	13,245 12 3

Heads.	From 1st July 1916 to 31st March 1917.	From 1st April 1917 to 30th June 1917.	Total.
1	2	3	4
SPECIAL CONTINGENCIES.			
	Rs. a. p.	Rs. a. p.	Rs. a. p.
Implements	498 14 0	3,041 0 0	3,539 14 0
Roads	300 0 0	...	300 0 0
Bricks	3,500 0 0	...	3,500 0 0
Buildings	1,100 0 0	...	1,100 0 0
Weigh-bridge	500 0 0	...	500 0 0
Fencing ... ..	...	1,351 8 0	1,351 8 0
Total	5,898 14 0	4,392 8 0	10,291 6 0
REGULAR CONTINGENCIES.			
Feed of Cattle	2,129 14 6	17 8 0	2,147 6 6
Seeds, plants and manures ... ..	...	7 12 0	7 12 0
Wages of Farm labourers	23,190 1 9	12,842 2 0	36,032 3 9
Petty Repairs	369 10 0	941 13 9	1,311 7 9
Purchase of Furniture	70 0 0	...	70 0 0
Service postage	100 0 0	...	100 0 0
Unspecified }	277 10 0	326 3 0	603 13 0
Charges }			
Freight of Machinery	9,600 0 0	3,536 8 0	13,136 8 0
Cost of fuel	736 14 6	4,100 0 0	4,836 14 6
Stores, Oils, etc.,	806 1 0	529 0 0	1,335 1 0
Total	37,280 3 9	22,360 14 9	59,581 2 6
Grand Total	52,839 12 0	30,248 8 9	83,118 4 9

17. *Staff*.—The present staff consists of :—

		Rs.
	Manager on	800 per mensem.
	Clerk „	75 „
Engine staff {	One mistri on	55 „
	Three Engine drivers on	22 „
	Three 2nd drivers	18 „
	Two Engine attendants	15 „
	One godown Mahurir	20 „
	One Garden Mahurir	25 „
	One Compounder	30 „
	Three peons on	10 „

18. *General*.—The Chief Commissioner inspected the farm with the Chief Secretary in December 1916.

Other visitors included the Commissioner, Assam Valley Districts, Mr. J. Mackenna, M.A., I.C.S., Agricultural Adviser to the Government of India, Mr. Milligan, Director of Agriculture, Bengal, Dr. Butler, Imperial Mycologist, Dr. Barber, Government Sugarcane Expert, Coimbatore, the Hon'ble Mr. Carter, C.I.E., with Messrs. Dixon and Prentice of Messrs. Turner, Morrison & Co., the Deputy Commissioner, Kamrup, the Conservator of Forests, and Mr. Urmson of Messrs. Kilburn & Co.

The Director of Land Records and Agriculture and the Deputy Director of Agriculture, Assam Valley, visited the farm frequently during the year.

The Manager continued in residence on the farm throughout the year.

The general health has been very good.

KAMRUP FARM, }
The 19th July 1917. }

A. A. MEGGITT,
Acting Deputy Director of Agriculture,
Assam Valley.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN
THE UPPER ASSAM VALLEY FOR THE YEAR END-
ING 30TH JUNE 1917.

Staff.—Maulvi Fazlul Haq Ahmed, Agricultural Superintendent, was in charge assisted by the Agricultural Inspector, Sibsagar, and four demonstrators. The number of days spent on tour by these officers is as follows :—

Agricultural Superintendent	...	...	255 days.
Agricultural Inspector	...	...	235 „
Demonstrator, Golaghat...	...	...	286 „
Demonstrator, Jorhat	...	...	279 „
Demonstrator, Sibsagar	...	...	243 „

The tendency to make frequent returns to headquarters by the demonstrators was very pronounced. Steps have been taken to put a stop to this practice. It is impossible that the demonstrations staff can get into that close touch with cultivators generally, which is so much to be desired if any good is to result, unless they make their tours of a more circular nature, staying overnight in the villages, instead of returning to headquarters so frequently. As an instance of what is meant, it may be mentioned that Demonstrator Anandi Ram Gohain (Golaghat), who spent 104 nights away from headquarters, succeeded in getting 50 manure pits erected during the year. The other two demonstrators, who returned to headquarters much more frequently, only succeeded in arranging for 12 and 4 manure pits, respectively.

2. Demonstrations were continued on :—

Paddy (a).—Manuring with Bonemeal and Stane's flour phosphate, combined in certain cases with green manuring.

(b) Green-manuring for paddy.

Sugarcane (a).—Superior varieties *versus* local canes.

(b) Green-manuring for cane.

(c) Three roller iron crushing mills.

Potatoes.—Superior varieties—demonstration and sale of.

Meston Ploughs.—Use of.

Conservation of Cattle Manure.—Construction of covered pits.

New crops.—Trials of.

Third year observation of plots manured with bonemeal in 1914.

3. *Paddy.*—These plots were observed for 3rd year residual effect. The 1st and 2nd year's results appeared in the two previous reports. The 3rd year results are as follows :—

Sibsagar District.

No.	Locality.			Grain in lbs. per acre.		Remarks.
				Bonemeal plots.	Untreated plots.	
1	2			3	4	5
1	Kanugaon	...	...	1,230	1,024	Average area of plots was $\frac{1}{3}$ rd acre.
2	Barkatonee	...	...	861	886	
3	Nahorance	...	...	1,020	898	
4	Kamargaon	...	...	1,506	1,144	
5	Charaibahi	...	...	1,199	898	
6	Hatigarh	...	...	1,491	1,037	
7	Bogidowl	...	...	916	860	
8	Namtiali	...	...	1,213	1,133	
9	Amguri	...	...	2,083	1,923	
10	Suffrai	...	...	1,611	1,586	
11	Pokamura	...	...	1,718	1,124	

The average increase per acre of the bonemeal over the untreated plots is 217 lbs grain. Valued at Rs. 3 per maund (82 lbs.), this shows an average net profit of Rs. 7-12 per acre for

the third year. Reference to previous reports will show that the total average net profit per acre for the three years works out at Rs. 17-8, or in other words against an initial outlay of Rs. 9 per acre the cultivator on the average stands to make a net profit of about Rs. 6 per acre per annum for the next three years.

4. *Second year Paddy Demonstrations.*—Commenced in 1915 at 8 centres in the Sibsagar district, one plot at each centre was treated with bonemeal, 3 maunds per acre, the other being a check plot.

The first year's results appeared in last year's report. The 2nd year's outturns were as follows :—

Sibsagar District.

No.	Locality.		Grain in lbs. per acre.		Remarks.
			Bonemeal plots.	Untreated plots.	
1	2		3	4	5
1	Kachojan	...	Grain pilfered.		Rejected.
2	Parbatia	...	1,300	780	
3	Khongia	...	1,054	645	
4	Kakotigaon	...	1,092	978	
5	Ahomgaon	...	1293	867	The plots were $\frac{1}{3}$ rd acre.
6	Gorokhiya-dowl	...	800	650	
7	Dhaialij	...	1,425	1,363	
8	Dhaporgaon	...	885	756	

Average increase due to bonemeal is 258 lbs. grain per acre, valued at Rs. 9-8. Last year the net profit after deducting the cost of bonemeal was Rs. 2-8 per acre. The total net profit for the first two years therefore averages out at Rs. 12 per acre.

5. *New Paddy Demonstrations.*—During 1916, several new centres were added; at each centre one plot was manured with bonemeal or flour phosphate 3 maunds per acre, the other being a check plot.

Sibsagar District.

No.	Locality.	Grain in lbs. per acre.		Untreated plots.	Remarks.
		Bonemeal plots.	Flour phosphate plots.		
1	2	3	4	5	6
1	Dergaon ...	...	1,263	992	
2	Rhadhola ...	1,185	...	990	Plots were $\frac{1}{3}$ rd acre.
3	Parbatia ...	...	1,610	1,240	
4	Murabazar ...	...	1,300	1,176	
5	Betbari ..	1,550	...	1,425	
6	Langkak ...	2,218	...	1,984	

The average increase due to bonemeal was 184 lbs. grain per acre, of flour phosphate 255 lbs. grain per acre, over corresponding unmanured plots. These results agree with previous experience in the Sibsagar district, *viz.*, that flour phosphate gives a better response than bonemeal for paddy (*vide* report for 1916).

At Rs. 3 per maund for grain, and at a cost for bonemeal and flour phosphate of Rs. 9 and Rs. 8-10 per acre respectively reckoning the whole cost of the manuring against this single crop, this shows a loss of Rs. 2 per acre in the case of bonemeal, and a small net profit of about Re. 1 per acre for flour phosphate.

Though the 2nd and 3rd years crops should, judging from experience, show a good profit, it is to be admitted that the increase of crop in the first year in this district, due to bonemeal or flour phosphate, is not of a sufficiently high order to encourage the cultivator to use these manures. As a rule he cannot wait 2 or 3 years for a return for his money, and generally refuses to look at anything which will not return him at least 100 per cent. on his outlay for manure in the first crop.

If combined with green-manure it is probable that bonemeal or flour phosphate would exert more influence on the first crop. A demonstration on these lines was made during the year, but owing to carelessness on the part of the demonstration staff, it failed.

6. *Sugarcane*.—Seven new demonstrations of superior varieties of cane were made in Sibsagar. The crops were damaged in places by jackals, but in every case our varieties beat the local canes.

The yields of *gur* per acre, average of six centres, were as follows :—

Introduced varieties	...	...	4,173 lbs. <i>gur</i> p r acre.
Local varieties	...	...	2,845 lbs. <i>gur</i> per acre.

Valuing the *gur* at only Rs 5 per maund of 82 lbs. which is less than its local market value, this shows an average net profit over the local varieties of some Rs. 100 *per acre*.

In three cases the variety demonstrations were combined with experiments in planting methods, and in two cases out of three planting in lines 3 feet apart gave a very considerable increase over the local method of planting in lines about 2 feet apart, which is so close as to prevent proper interculture.

Using the same variety of cane, the average at these three centres was as follows :—

Planted in lines 3 feet apart	...	...	4,691 lbs. <i>gur</i> per acre.
" " " 2 feet " (local method)	...	...	3,637 lbs. <i>gur</i> per acre.

Ratoon Canes.—Four demonstrations from last year were ratooned. In all cases again our exotic varieties gave a considerable increase over the local canes, though the average yield of *gur* per acre was low, as the local ryots do not usually ratoon at all, and can only with great difficulty be persuaded to put any trouble or money into a ratoon crop. It is the case also that the Demonstration staff are apt to neglect second year demonstrations, in favour of new work.

The average increase for the four centres in favour of our varieties was some 1,120 lbs. *gur* per acre, valued at Rs. 90 approximately

Green-manuring for Cane.—This was demonstrated at two centres, cowpeas (*vigna catieng*) being grown and hoed in the year previous to planting. The benefit to the succeeding crop of cane was clearly marked, the check plots being distinctly inferior in growth to the green-manured ones. It also seems to be the fact that under cultivators' conditions our introduced varieties respond better to green-manuring than do the local canes, and this

emphasises the opinion I expressed last year that the ryot must adopt better cultivation methods *pari passu* with the cultivation of better varieties.

The average increase for the two centres in favour of green-manuring was 502 lbs. *gur* per acre, valued at Rs. 31-4, at a cost per acre of Rs. 4-8 for cowpea seed. This is a very favourable result, and agrees with experience of many years' work on the Jorhat Farm.

Three roller iron crushing mills.—Twelve mills were sold in the district, and others were hired out at a nominal rate.

The demand is increasing, as a demonstration never fails to impress cultivators of their value. The capital necessary to purchase, is however generally wanting. At the risk of being wearisome, I must again repeat that there would appear to be a great field for co-operative societies in this connection.

Distribution of cuttings of superior cane varieties.—A fairly large area of cane was grown on the farm at Jorhat to meet the rapidly increasing demand for cane setts, and some 107,000 setts were sent out during March and April. The total number of setts distributed from the Kamrup and Jorhat farms this year, of the three varieties B376, B-117 and Striped Mauritius was some 3½ lakhs.

Potatoes, Superior Varieties.—Demonstrations were made in six centres. More would have been possible, but for the flood relief work in Nowzong which much reduced the quantity of potatoes available for demonstration purposes, and to meet an increasing demand for sale. At each centre, "Up-to-date" was planted against local bazar seed, and in every case this variety gave an increase over the local one.

The average yields per acre for six centres were as follows:—

For "Up-to-date"	6,662 lbs. per acre.
" local varieties	3,351 " " "

This is over 100 per cent. increase in favour of Up-to-date.

Meston Ploughs.—I remarked last year on failure of the demonstration staff to demonstrate this useful, cheap and light plough. On the plea that the cultivators consider the Meston plough too heavy for their small bullocks, demonstration of its usefulness has again been neglected. In many places throughout the district there may be found bullocks big and strong enough for this plough, and one has occasionally heard that buffaloes exist in Assam! Where this plough has been adopted its utility and efficacy are highly spoken of. I look to the Agricultural Superintendent and his staff for a very different report under this head next year.

9. *Conservation of Cattle Manure.*—The construction of model manure pits, covered in, in the villages has been continued. Constant effort being necessary to overcome the conservativeness of the ryots, certain of the demonstrators failed to achieve much. It is much to the credit of Demonstrator Anandi Ram Gohain that he has constructed some 50 manure pits or sheds in his circle, as against 12 and 4 in the other two subdivisions. A little more energy might advantageously be shown by the Agricultural Inspector in respect of the conservation and proper use of cattle manure.

10. *Introduction of New Crops.*—In connection with flood relief work in Nowgong, *boro* paddy (250 mds.), wheat (40 mds.) and potatoes (120 mds.), all practically new crops to the locality, were distributed for seed and every assistance was given to the cultivators, the Agricultural Inspector, Sibhsagar, being specially deputed for this purpose. Taking everything into consideration the success attained was quite good.

In one centre an experimental harvesting of *boro* paddy gave 39.5 maunds of unhusked grain per acre; wheat showed an output of 700 lbs. grain per acre.

Potatoes grew well everywhere but were generally ruined by cutworms and red ants previous to harvest. Signs are not wanting that the cultivation of these crops will be carried on and extended in Nowgong; this is receiving every encouragement at our hands. A demonstrator has recently been stationed at Kampur, and it is proposed to locate an Agricultural Inspector in the district shortly.

A. A. MEGGITT,

Jorhat, Acting Deputy Director of Agriculture,
Assam Valley.

The 11th August 1917.

REPORT ON THE AGRICULTURAL DEMONSTRATION WORK IN KAMRUP DISTRICT FOR THE YEAR ENDING 30TH JUNE 1917.

1. *Staff*.—This district forms part of the charge of Maulvi Fazlul Haq Ahmed, Agricultural Superintendent, Assam Valley, who is assisted by Babu Satyendra Chandra Dutt, Agricultural Inspector, Kamrup district and by two Agricultural Demonstrators who were appointed to Nalbari and Gauhati Circles on the 1st November 1916. During the year the Agricultural Inspector was on tour for 261 days including about four weeks spent, in Bengal and in the Surma Valley, on relief work in connexion with the floods in Nowgong.

2. *Demonstration work*.—This work was continued along similar lines to that of previous years, the main points to which attention was devoted were :—

- (1) Manuring and variety demonstration with the rice crop.
- (2) Distribution of superior varieties of sugarcane and demonstrations with the three-roller iron sugarcane crushing mills.
- (3) Distribution of Shillong potatoes.
- (4) Jute demonstrations.
- (5) Trial of fodder and miscellaneous crops.
- (6) Introduction of improved ploughs.
- (7) Conservation of cattle manure.

3. *Manuring of the rice crop*.—(1) This work was started in 1913 but the demonstrations begun in that year have proved of little value during the succeeding years owing to the irregular results given.

Third year demonstrations.—(2) Seven demonstrations manured with bonemeal at 247 pounds per acre in 1914, have been under

observation since ; the yields last year were :--

GRAIN PER ACRE IN LBS.

No.	Locality.	Bonemeal plots.	Untreated plots.	Remarks.
1	2	3	4	5
1	Rangia	1,070	850	Ahu crop only.
2	Septi	212	210	Ditto.
3	Digaru	856	586	Ditto.
4	Chaukhuti	2,376	1,481	Ditto.
5	Parakachi	2,146	1,768	Ahu and sali.
6	Ajira	1,984	1,691	Sali only.
7	Bilpar	1,770	1,878	Sali only. Part of bonemeal plot injured by disc-a-e.

At Chaukhuti the results have been so extraordinarily good for the past two years that one is forced to the conclusion that there must be some special reason operative in that particular place which makes the results inapplicable to the district generally. These figures together with those from the Bilpar centre are therefore disregarded. The average increase from the remaining five centres is 238 lbs. per acre which added to the 120 lbs. obtained in the previous year makes a total increase in two years worth about Rs. 13-8 valuing the paddy at Rs. 3 per maund.

(3) *Second year demonstrations*—These were manured with bonemeal at 247 pounds per acre in 1915. The results were:—

GRAIN PER ACRE IN LBS.

No.	Locality.	Bonemeal plots.	Untreated plots.	Remarks.
1	2	3	4	5
1	Nalbari	722	484	Ahu and sali crops.
2	Gobindpur	982	346	Ditto.
3	Palasbari	1,84	1,102	Sali only.
4	Uparsali	2,337	1,622	Ditto.

Omitting the results of No. 2 centre which appear somewhat doubtful, the average increase per acre comes to 346 lbs. valued at Rs. 13.

As the cost of manuring in the previous year was Rs. 9 and as there was then some increase although not sufficient to pay for the cost of manure, this result may be considered quite satisfactory.

(4) *Second year green manure demonstration.*—A crop of *dhaincha* was grown at these centres in 1915. The yields obtained last year were :—

GRAIN PER ACRE IN LBS.

No.	Locality.	Dhaincha plots.	Untreated plot.	Remarks.
1	2	3	4	5
1	Nalbari	2,876	1,622	Abu and sali.
2	Sorbhog	1,754	1,620	Sali only.

These two centres show an average increase, from the use of a *dhaincha* crop in the previous year, of 444 lbs. worth about Rs. 16-8.

(5) *First year demonstrations.*—These were manured with green manure alone and with green manure in conjunction with bon-meal.

GRAIN PER ACRE IN LBS.

No.	Locality.	Green manure plots.	Green manure and bon-meal plots.	Untreated.	Remarks.
1	2	3	4	5	6
1	Tonjra	708	1,440	672	Sali only.
2	Kuara	1,758	1,85	1,434	Ditto.
3	Nalbari	1,920	1,942	1,686	Ditto.
4	Sorbhog	1,832	1,514	1,780	Ditto.

This shows an average increase of 164 lbs. from the green manure. As the increase is worth Rs. 6 and as the expenditure was about Rs. 1.8 this is a promising line of work. The increase of 301 lbs. obtained when bonemeal is used in conjunction with green manures is almost double, but the expenditure is much higher in proportion. The extra crop is worth Rs. 11.4 while the extra expenditure has been only slightly less than that sum. However increased crops may also be expected in the second and third years without any further expenditure.

(6) *Demonstrations with improved varieties of paddy.*—*Indra sali*, a variety introduced by the Bengal Agricultural Department, and *George sali* a variety introduced by Srijut Narayan Barua, Honorary Correspondent, were tested against the local varieties, the yields being as follows:—

GRAIN PER ACRE IN LBS.

No.	Locality.	George sali.	Local sali.	Indra sali.	Remarks.
1	2	3	4	5	6
1	Gobindpur ...	2,556	2,716	2,778	Soil conditions somewhat uneven.
2	Beitola ...	1,696	1,628	1,702	
3	Nalbari ...	2,112	2,303	1,810	

From the average results obtained at the first two centres, both *George sali* and *Indra sali* seem to be heavier cropping varieties than the local kinds. There are indications that water and soil conditions necessary for these varieties differ somewhat, and the work will therefore require to be carried further before conclusions can be drawn.

4. *Demonstrations with superior varieties of sugarcane.*—(1) Six demonstrations were laid down. Two of these had to be given up as the crop was damaged by jackals, the yields of μr per acre obtained from the other four demonstrations together

with the outturn obtained from the ratoon crops of the previous years planting at two centres are shown in the following table :—

YIELD OF GUR PER ACRE IN LBS.

No.	Locality.	Improved canes.	Local canes.	Remarks.
1	2	3	4	5
1	Changchari ...	5,808	3,932	
2	Kathiamari ...	5,188	2,826	
3	Palasbari ...	4,188	2,558	
4	Gobindpur ...	4,758	2,818	
5	Parakuchi ...	3,980	2,772	Ratoon crop.
6	Ditto ...	892	574	Ditto.
7	Average yields ...	4,134	2,585	

The improved canes used were striped Mauritius, B-147, and B-376 from the Jorhat Farm. There can be no doubt of the superiority of these canes to the local varieties and that this is recognised by the cultivators is evident from the fact that in 1915, 13,000 cane sets were sold and in 1916, 65,000. Thousands more could have been sold had funds been available. In addition to the sets sold at current market rates 14,000 sets were distributed free for demonstration purposes.

(2) *Demonstrations with three roller mills.*—Five three roller cane-crushing mills were used in the district for carrying out demonstrations. The results were so successful that 19 such mills were sold through the seed depôt to cultivators in the Kamrup district.

5. Distribution of Shillong potatoes :—

(1) Five demonstrations were laid down to compare seed potatoes as supplied by the Upper Shillong Farm with local and Khasi mixed seed as ordinarily sold in the bazars.

The yields per acre were :—

No.	Locality.	Shillong seed.	Local seed.
1	2	3	4
		Tons.	Tons.
1	Nankar bhausa	7.9	3.0
2	Gobindpur	5.6	3.9
3	Sadlipar	6.7	5.6
4	Sorbhog	2.3	1.2
5	Kamalpur	1.5	.9
	Average yields	4.8	2.9

These demonstrations show in every case an increase of crop in favour of the Shillong seed, the average increase per acre being 1.9 tons which valued at Rs. 70 per ton gives an increased money value of Rs. 130 per acre.

(2) Potato spacing demonstration. —

One demonstration was carried out at Khanamukh to test the advantage of planting out potato sets at a somewhat wider spacing than that usually adopted. At this centre, sets planted 24 inches apart gave a crop of 3.3 tons while similar sets planted at 20 inches gave a crop of 2.9 tons.

6. *Jute demonstration.* At Sadlipar Finlow's improved seed was tested against local seed. The result in this case was that Finlow's seed gave an outturn of 2,047 pounds of fibre per acre as against 1,399 pounds from the country seed. This increase of 648 pounds which was worth Rs. 60 to Rs. 70 per acre was a handsome one. The demand for the improved Bengal seed was so great this year that our supply was quite inadequate and many cultivators who wished to use the improved seed had to sow the country seed for another year.

7. Trial of fodder and miscellaneous crops : —

(1) *Jowar* was grown successfully at Nomati and Gobindpur and the produce was fed to cattle. A third demonstration at Malbari failed through the death of the seedlings when they were a few inches high.

(2) Barley was grown near Nalbari by Srijut Senapati Pa-hok.

(3) *Boro* paddy was again grown successfully. The demand or seed of *Boro* paddy is increasing yearly.

(4) Ground nuts met with continued success at the few centres at which they were tried.

8. *Introduction of Weston ploughs*.—Demonstrations were carried out successfully in various parts of the district and 23 new ploughs were sold during the season.

9. *Conservation of cattle manure*.—About 20 covered manure pits were erected during the year. These were principally in the Gauhati Circle of the district and credit is due to the demonstrator of that circle to whose exertions this progress is mainly due.

J. W. McKAY,

Camp Karimganj, }
The 10th August 1917. }

Deputy Director of Agriculture,
Surma Valley and Hill Districts.

**REPORT ON AGRICULTURAL DEMONSTRATIONS IN
KHASI AND JAINTIA HILLS AND GARO HILLS
DISTRICTS FOR THE YEAR ENDING THE 30TH
JUNE 1917.**

During the year U Harry Singh was in charge of the Demonstration work in the hills. He was assisted by three demonstrators headquartered at Shillong, Mauphlung and Jowai, respectively and by one demonstrator with headquarters at Tura in the Garo Hills.

2. *Rice*.—The majority of rice growers in the district have realised the value of bonemeal for wet-land paddy. Fresh demonstrations have therefore been reduced from 20 in the previous year to 5 in the present year. As in previous year two plots, each about $\frac{3}{4}$ acre in area were taken at each centre. One was manured with bonemeal at the rate of 247 lbs. per acre and the other left untreated as a check.

The first year's results are given in the following table:—

No.	Locality.	Cultivator.	Yield of grain in lbs. per acre.	
			Bonemeal plot.	Untreated plot.
1	2	3	4	5
1	Nongthymmai ...	U Nori ...	1,506	1,059
2	Lumpyngdeng ...	Hinmuni ...	1,748	1,109
3	Mawrhoh ...	Kha-i ...	1,547	1,109
4	Umiap ...	Ka Nesi ...	975	543
5	Myriaw ...	Siem Myriaw ...	1,092	792
		Average yield per acre ...	1,374	919

The average increase in crop due to bonemeal is therefore 455 lbs. per acre. Valuing this grain at Rs. 3 per maund and the bonemeal at Rs. 4-8-0, the net profit per acre works out at Rs. 3-9-0 for the first year of application. Any increase obtained in subsequent years will be pure profit, and experience shows

that bonemeal favourably affects the crop for at least three years. These plots are being kept under observation as to the second and third year's results of the initial dressing of bonemeal.

Second year demonstrations.—The 20 demonstrations laid down in 1915 were kept under observation without further manuring. At four centres the demonstrations were injured by floods, and the results are therefore neglected. The yields obtained at the remaining 16 centres are shown in the accompanying table :—

No.	Locality.	Cultivator.	Yield of grain in lbs. per acre.		Increase in lbs. per acre.
			Bonemeal plot.	Untreated plot.	
1	2	3	4	5	6
1	Mawsynrie ...	Mrival ...	1,095	660	435
2	Umjapung ...	Klat ...	1,080	846	234
3	Umsohlang ...	Poet ...	1,470	975	495
4	Um-aw ...	Biang ...	1,095	869	226
5	Mawrong ...	Kpa Ka Sen ...	2,040	1,860	180
6	Nonglakhiat ...	Bha ...	1,140	1,020	120
7	Mawsiatkhnam ...	Kalicharon ...	1,500	1,296	204
8	Untkhah ...	Nimor ...	1,458	978	480
9	Rambrai ...	Hari Siem ...	870	768	102
10	Nongspung ...	Kpa Salihon ...	1,176	975	201
11	Nongwi ...	Kir Lyngdoh ...	1,065	774	291
12	Laitdom ...	Morkin ...	1,218	1,062	156
13	Khlhtyrshi ...	Kpa Manik ...	787	411	376
14	Rymbai ...	Wanbareh ...	611	443	168
15	Kyndongtuber ...	Kpa Kaksel ...	1,110	906	114
16	Mawdymmai ...	Kpa Isaiah ...	1,855	1,308	547
		Average yields ...	1,223	952	271

This average increase of 271 lbs. is worth Rs. 10-2-7 at current prices.

These demonstrations yielded an average net profit of Rs. 4.8 per acre in the first year, after charging the entire cost of bonemeal to that year. The total net profit per acre from the first two years of this series of demonstrations, therefore averages Rs. 14-10-7.

Third year demonstrations.—The ten centres commenced in 1914, of which the first and second years' results appeared in the reports for 1915 and 1916, were kept under observation for the third year. At three centres the demonstrations were injured by floods and are therefore neglected.

The following yields were obtained from the remaining seven demonstrations :—

No.	Locality.	Cultivator.	Yield of grain in lbs. per acre.	
			Bonemeal plots.	Untreated plots.
1	2	3	4	5
1	Lawbyrtun ...	Suba Myntri ...	728	672
2	Nongkasen ...	Bang Singh ...	1,110	600
3	Pariong ...	Rison Singh ...	815	744
4	Jakrem ...	Kourai ...	1,164	1,133
5	Nongjingi ...	Hed Doloi ...	891	779
6	Wahjajer ...	Ket Phawa ...	939	540
7	Nartiang ...	U Kat ...	1,025	942
		Average yields ...	952	773

These seven centres show an average increase of 179 lbs. of grain from the plots manured with bonemeal. This at current rates is worth Rs. 6-12-0. These centres showed an average net profit per acre of Rs. 32-4-0 for the first two years. The total net profit for the three years for which these demonstrations have been carried on is therefore Rs. 30, on an initial expenditure of Rs. 15 per acre.

The trial laid down in 1914 using raw Egyptian phosphate against bonemeal, against no manure was continued for a third year without further manure. In the first year the Egyptian phosphate gave an increase of 150 lbs. of grain per acre, in the

second year a decrease of 36 lbs. per acre and in the past year a further decrease of 33 lbs. per acre. It is clear from this that raw mineral phosphates are less effective than bonemeal under the peculiar soil and climatic conditions of the place. The results of the demonstration are given below :—

Locality.	Cultivator.	Yield of grain in lbs. per acre.		Unmanured.
		Bonemeal plots.	Flour phosphate.	
1	2	3	4	5
Bannium ...	Kpa U Kumoh ...	1,915	825	858

During the year demonstrations with bonemeal for upland paddy were started in 15 centres, five centres being situated in each of the Jowai, Mauphlant and Shillong circles. The selected plots were as nearly as possible 1/4th acre each. One plot was manured with bonemeal at the rate of 247 lbs. per acre and another was left untreated for comparison.

The results for the first year are given in the following table :—

No.	Locality.	Cultivator.	Yield of grain in lbs. per acre.		Remarks.
			Bonemeal plots.	Untreated plots.	
1	2	3	4	5	6
		<i>Khasi Hills.</i>			
1	Mawrah ...	Sabu Roy ...	1,056	650	
2	Marbisu ...	Kpa Honmu ...	447	411	
3	Mawkrich ...	Kmie U Hadon ...	651	606	
4	Myliem ...	Ka Jim ...	840	825	
5	Nongkseh ...	U Sami ...	915	312	

No.	Locality.	Cultivator.	Yield of grain in lbs. per acre.		Remarks.
			Bonemeal plots.	Unmanured plots.	
1	2	3	4	5	6
		<i>Khasi Hills—</i> concl'd.			
6	Umjajen ...	U Hon ...	1,050	803	
7	Bhih ...	U Nobin ...	732	570	
8	Langlibrin ...	U Sahon ...	879	318	
9	Umsaw Mawtawar	U Sad ...	687	318	
10	Umshing ...	U Mad Singer ...	...	...	Destroyed by cattle.
		<i>Jaintia Hills.</i>			
1	Um Mawlong ...	Shai Bareh ...	774	674	
2	Pamra ...	Thma ...	320	256	
3	Tkhiang ...	Doloi ...	290	243	
4	Syntoo Ksiar ...	Riangmon Shulai ...	349	323	
6	Mih Myntodoo ...	Muni ...	614	545	
		Average yield ...	686	476	
		Increase ...	210		

As might be expected, the effect of bonemeal on dry land paddy is not so marked in the year of application, as it is in the case of wet-land paddy. From the average results obtained in these 14 demonstrations it will be seen that 247 lbs. of bonemeal has produced an extra crop of 210 lbs. of grain. This is not sufficient to pay the initial cost of the manure.

It is, however, likely that much better results may be obtained in the next and succeeding years, and it is proposed to weigh the produce for two more years.

During the year, at one centre in each of Shillong, Mawphlang and Jowai circles a former demonstration was redressed with bonemeal. These demonstrations were manured with bonemeal in 1914, and received no manure in the intervening

years. The effect of this second dressing of bonemeal will be seen from the accompanying table.

No.	Locality.	Cultivator.	Yield of grain in lbs. per acre.	
			Bonemeal plots.	Untreated plots.
1	2	3	4	5
1	Shangpnag ...	Smon Dhar ...	1,443	754
2	Umlyngka ...	Kpa Ka Kwai ...	699	483
3	Mairang ...	Kmie Ka Selina ...	1,464	1,350
		Average yield ...	1,169	862
		Increase per acre ...	307	

These results indicate that a second dressing at the end of the first three years is likely to be profitable. The average increase obtained is almost sufficient to pay the full cost of the manure used, and as similar good results may be expected in the second and third years, this second dressing of bonemeal is likely to give a fair return.

3. *Bone-crushing operations and bonemeal distribution.*—The total receipt of raw bones during the year was 5.41 tons. From this 3.75 tons were ground and produced 3.6 tons of bonemeal. At the commencement of the year there was a balance of bonemeal in stock of .7 tons, and during the year a consignment of 4 tons was purchased in Calcutta and brought to the Jowai district, thus making a supply of 11.7 tons of bonemeal available for distribution in the Hills.

This was distributed as follows :—

			Tons.
Used at the Upper Shillong Farm	...	...	.31
For demonstration in the Hills	...	...	.25
Exchanged for raw bones	...	...	.82
Sold at the Farm	...	...	2.52
Sold at Jowai	...	...	7.67
Supplied to Honorary Correspondents	...	...	.14
Total	...	...	11.71

4. *Potato growing*.—During the year under report depôts for the sale of seed potatoes were opened at 4 centres, *vis.*:—

				Quantity of potatoes sold Tons.
(1) Marbais	...	...	...	47
(2) Lad Mawphlang	...	...	...	1.22
(3) Dumpep	...	...	...	45
(4) Jowai	...	...	...	36
Total				2.50

Demonstrations were carried out in two centres in the Jowai subdivision, where this crop is not much cultivated. One maund of seed potatoes was planted at each centre with the following results :—

Local ty.	Name of cultivator.	Yield from 80 lbs. of seed.
1	2	3
Nongbah	Jakat Pasie	477 lbs.
Shangpung	Doloi	360 lbs.

The results are promising and the demonstrations are being continued in the present year.

Spraying with Bordeaux mixture.—Ten acres of potatoes were sprayed by the Department's sprayers against two acres in the previous year.

Although considerable damage is done each year to the potato crop by potato blight, the cultivators do not yet fully appreciate the value of spraying as a preventive, and the practice is not adopted to any great extent.

5. *Ploughing demonstrations*.—A ploughing demonstration was carried out at Nongpoh to compare the work done by the small Turn-wrest plough, against that done by the country plough. The costs of labour and yields of crop are recorded below:—

	Yield of paddy in lbs. per acre.	No of working hours spent on the work.	Rate per day of 8 hours.	Total cost
1	2	3	4	5
Turn-wrest plough	1,929	24	Rs. 2. 1 14	Rs. 4 5 11
Country plough	1,563	72	1 12	6 12

The result is encouraging and these demonstrations with the proved plough will be continued.

6. *Insect pests*.—Two kinds of rice pests appeared in the district during the year, *viz*:—Rice fulgroid and rice bugs. Remedial measures were taken by our staff. The ravages of rice fulgroid were successfully checked at four centres by the following means. The water in the affected field was covered with a layer of kerosine oil. The insects were then disturbed by drawing a rope or bamboo across the affected plants. When so disturbed these insects drop into the water and are quickly killed by the kerosine oil.

Rice bugs were reported to be seriously injuring the young paddy crops at Umsaijain and Wah Umbah during last year. The Entomological Assistant visited these places and gave instructions for combating the pest by sweeping a bag net over the affected crops. This proved successful.

7. *Grafting of fruit trees*.—This work was continued as in previous years, demonstrations being given by the demonstrators from time to time on their tours. The following grafts were made in 20 villages :—

Oranges	(budded)	829
Pears		565
Peaches		191
Apples		25
Plums		89
Apricots		32
Quince		4
Total		1,726

Up to the present no signs of disease have appeared on the oranges so budded.

8. *Supply of seeds and plants*.—The following seeds and plants were distributed during the year :—

Garro Cotton seed	...	4	lbs.
Khaki variety of cotton	...	25	"
Seed of Shillong pine	...	65	"
Paddy seed (from Mawsiat Khnam)		56	"
Arrowroots (from Mahaleo)	...	4	"
Coffee seed (ditto)	...	1	"

Seeds of squash	...	...	6 number.
Cuttings of Cassava	...	210	"
Ditto black pepper	...	60	"
Ditto Figs	...	10	"
Orange seedlings	...	2,272	"
Pomelo	...	100	"
Lime	...	550	"
Bitter orange	...	12	"
Citrus	...	4	"
Pear grafts	...	72	"
Pine apple suckers (from Wabjain)	...	3110	"
Coffee seedlings	...	160	"

9. *Pan disease*.—The Imperial Bacteriologist, Pusa, visited Shillong and Cherrapunji and procured diseased specimens of plants for further investigations but no report has yet been received.

DEMONSTRATIONS IN THE GARO HILLS.

10. During the year potatodemonstrations with winter crop were laid down at four centres. One maund of seed was used in each centre and this was planted on approximately 1/10th of an acre. The yields were as follows :—

Locality.	Yield from 80 lbs. of seed.	Remarks.
1	2	3
Mahendraganj	349	
Dalu	261	
Tura	54	Destroyed by porcupines.
Mukdengra	Nil	Destroyed by wild pigs.

The demonstrations were promising on suitable localities and the work is being continued in the present year.

11. *New demonstrations.*—Demonstrations with Garo cotton are being carried out in three centres in the Jaintia Hills and in one centre at Nongpoh.

Demonstrations with local, well reputed paddy seed are being carried out at 5 centres in the Jowai subdivision.

An additional demonstrator was appointed to the Khasi Hills towards the end of the year. His headquarters will be at Umran and he will work in the districts lying around that place.

Shillong,

The 8th September 1917.

J. W. MCKAY,

*Deputy Director of Agriculture,
Surma Valley, Assam.*

REPORT ON THE AGRICULTURAL DEMONSTRATION WORK IN THE SURMA VALLEY FOR THE YEAR ENDING THE 30TH JUNE 1917.

The demonstration staff in the Surma Valley now consists of,
one Agricultural Superintendent—Mr. L. Bar-
thakur who is assisted by —

two Agricultural Inspectors, Babu Benode Behari Das, Agri-
cultural Inspector, Sylhet, and Mr. Lalit Mohan Das who was ap-
pointed in August 1916, as Agricultural Inspector, Karimganj
and Cachar.

At the commencement of the year we had only one Demons-
trator, who was stationed at Karimganj. During the year, five
others were appointed, and we have at the end of the present
year a Demonstrator for each of the following districts :—North
Sylhet, South Sylhet, Habiganj, Karimganj, Cachar, North Ca-
char Hills.

2. At the commencement of demonstration work in the Surma
Valley there was little to demonstrate, as little
previous experimental work had been possible.
The work was then practically limited to bone-
meal manuring for the paddy crop. During the past two years
a small staff has been brought together and these officers are now
engaged in demonstrating various agricultural improvements.
They have tried the effect of green manuring for the paddy crop
and have experimented with limestone on various crops. Im-
proved sugarcane sets from Jorhat have been grown alongside the
country varieties. Demonstrations with iron three-roller sugar-
cane-crushing mills have been carried out. Jute variety and
manuring demonstrations have been started. Fodder and miscel-
laneous rain crops and a variety of cold-weather crops have been
tried. In addition to this work, most of the members of our
small staff have been engaged for considerable periods, in each
of the last two years, in the purchase and distribution of seeds as
flood relief.

3. Paddy manurial demonstrations laid down in 1916 were of
three kinds (a) bonemeal used alone, (b) bone-
meal used in conjunction with a green crop of
dhaincha, (c) *Dhaincha* used alone. Bone-
meal was applied at the rate of 247 pounds per acre and *dhain-*
cha seed at 30 pounds per acre.

The yields were as follows :—

YIELD IN POUNDS PER ACRE.

No.	Locality.	Dhaincha.	Unmanured.	Bonemeal.	Unmanured.	Bonemeal and Dhaincha.	Unmanured.
1	2	3	4	5	6	7	8
1	Takubnagar	2,326	1,972	2,983	2,763	3,102	1,972
2	Barlekha	1,922	1,710	3,444	2,772	1,694	1,524
3	Ditto	1,916	1,808	...	...	...	...
4	Ditto	1,974	1,804	2,229	2,552	...	...
5	Patharia	2,474	1,849	4,338	3,040	3,449	3,136
6	Ditto ... ..	...	...	2,466	2,222	...	...
7	Chotalekha	2,270	1,828	1,904	1,798	...	...
8	Ditto ... ..	...	...	2,850	2,032	1,598	1,412
9	Ditto	1,669	1,412	2,386	1,978	...	...
	Average yields	2,335	1,781	2,859	2,618	2,453	2,011
Average increase from manure		553		241		442	
		Rs. a. p.		Rs. a. p.		Rs. a. p.	
Average increase in value at Rs. 3 per maund of 50 pounds.		20 12 0		9 0 0		16 8 0	
Cost of manures, bonemeal at Rs. 3 per maund of 50 pounds, Dhaincha at Rs. 5 per maund.		1 12 0		9 0 0		10 12 0	

The average yields obtained from a further eight bonemeal demonstrations which were carried out in Khitta and Kauria parganas Sylhet, were as follows. The plots manured with bonemeal at the rate of 247 pounds per acre gave an average outturn per acre of 2,000 pounds against a yield of 1,626 pounds from the unmanured plots. This means that the application of bonemeal costing Rs. 9 per acre gave an increased outturn worth about Rs. 14 in the first year. Any further increase in the crop in the following years will, of course, add still further to the profits.

4. These demonstrations have been kept under observation since they were laid down. The yields were as follows in the present year :—

No.	Locality.	Year when demonstration started.	Yield of paddy in lbs. per acre.		Increase on lbs. per acre.			Value of increase.
			Bonemeal plot.	Umanur-ed plot.	In 1915.	In previous years.	Total increase.	
1	2	3	4	5	6	7	8	9
			lbs.	lbs.	lbs.	lbs.	lbs.	Rs. s. p.
1	Chagghat ...	1915 ...	9,060	750	2,200	2,714	4,080	86 12 0
2	Barlekha ...	1915 ...	1,752	1,576	210	52	268	10 0 0
3	Ditto ...	" ...	1,978	1,820	748	100	938	35 4 0
4	Potharia ...	" ...	1,029	1,174	-140	278	132	4 14 0
5	Ditto ...	" ...	1,600	1,582	218	128	546	12 12 0
6	Ditto ...	" ...	3,182	2,388	794	662	1,456	54 4 0
7	Ditto ...	" ...	2,710	2,548	162	24	186	7 12 0
8	Ditto ...	" ...	2,164	1,746	418	172	590	22 2 0
9	Ditto ...	" ...	2,412	3,082	-670	22	-648	-24 8 0
10	Ditto ...	" ...	8,174	2,870	304	168	462	17 4 0
11	Ditto ...	" ...	1,892	1,290	606	264	900	36 0 0
12	Chotalekha ...	" ...	1,210	1,026	174	224	808	14 14 0

The results obtained at centres one and nine differ so much from the normal that they are not strictly comparable, and should therefore be left out of consideration. The average increase from the remaining ten centres is worth about Rs. 21-8 per acre when paddy is valued at Rs 3 per maund. As the expenditure incurred for manure was about Rs. 9 per acre the result is satisfactory.

5. Six demonstrations were laid down in the previous year. In these, slaked lime was applied at the rate of 823 lbs. per acre. There was no noticeable improvement from the use of the lime and no weighings were made.

Slaked lime for the
paddy crop on peaty
soil.

6. These demonstrations were of two kinds:—(a) Introduction of three improved varieties of sugarcane which have proved so successful at Jorhat and in the Assam Valley, viz., Striped Mauritius, B-373 and B-147. (b) Introduction of the improved three-roller cane-crushing iron mill.

Sugarcane demon-
strations.

With regard to the introduction of the improved varieties which had been commenced in a small way in the previous year, it was found that there was already a marked demand for these canes in those districts where they had been planted in 1915. A total of 15,000 sets were brought from the Khagrabari Sugarcane Farm. Of these 14,000 were distributed free for demonstration purposes and 1,000 sets were sold to cultivators at market prices. The demand was so keen that, had funds been available, very much larger quantities could have been sold.

Our work with the improved three-roller cane-crushing mill has not yet had time to show much effect. One such mill was used for the first time by us in the previous year for demonstration work. In the year under report, five other mills were brought to the valley. Four of these were sold to cultivators and the fifth was used for extending our demonstrations. A large number of demonstrations was carried out to compare the extractions of juice obtained by the three-roller iron mill against that obtained by the use of the ordinary wooden mills. The results obtained from a large number of these experiments show that the iron mills give about 30 per cent. greater extraction of juice, than was obtained by the use of the local wooden mills.

7. Seed of Mr. Finlow's improved variety of jute was distributed to cultivators near Teliapara. The crop was superior to that produced by local seed, but on

Jute demonstrations.

account of the smallness of our staff it was found impossible to obtain actual weights of fibre. The cultivators were, however, impressed with the superiority of the improved variety of jute, and a large demand for the seed of this variety followed. In the present year a largely increased number of demonstrations has been laid down. Demonstrations on the effect of bonemeal on this crop have also been arranged, and from the promising appearance of the crops at the end of the year under report, useful results are expected.

8. Ground nuts were tried on a small scale at one centre. The soil was of suitable texture, and as it was situated on the slope of a *teela*, it was free from water logging, and consequently the crop grew luxuriantly and yielded well. Ground nuts are saleable at a price varying from Rs. 5 to Rs. 10 per maund, and there would, therefore, seem to be a future for the development of this crop on the higher lands or *teela* slopes.

Jowar was tried in a few centres as a fodder crop. At two centres where the land selected for the experiment was somewhat above the ordinary water-level of the rainy season, fairly good crops were obtained.

At the end of the year under report a larger number of demonstrations of ground nuts, of mixed *jowar* and cowpea for fodder, and of *jowar* alone for the same purpose have been laid down. Ground nuts are very promising where planted on suitable high land, so also are *jowar* and cowpea. These crops will not, however, stand any water logging, and consequently the extension of their cultivation is limited to districts where suitable high land is available.

9. The injurious flood which took place at the end of the rainy season of 1916 occurred at such a late date, that it was impossible to plant paddy to take the place of the crop which had been destroyed.

Under these circumstances it was felt that an attempt should be made to extend the cultivation of cold-weather crops as far as possible. Accordingly arrangements were made to procure seed of such crops as would be likely to grow successfully under the conditions prevailing in the district.

The following quantities of seeds were procured and distributed over those areas where most damage had been done :—

Name of seeds.				Tons.	Value.
1				2	3
					Rs. a. P.
Potatoes	...	...	...	40.25	5,547 8 5
Linseed ...	...	...	...	14.33	3,120 2 11½
Mustard	...	...	...	9.25	1,416 10 3¼

Name of seeds.	Tons.	Value.
1	2	3
		Rs. a. p.
Khetari	5.66	605 3 4
Valai	3	334 13 11
Bram	2.44	308 13 6
Peas	2.33	305 13 5
Wheat	1.75	299 0 6
Earley ... ..	.33	39 8 3
Boro paddy	1.66	196 14 3
Small quantities of <i>masur</i> , <i>mug</i> and <i>oats</i> were also obtained. The value of these was ...	...	81 2 2
Total ...	81.53	12,160 11 0

Oilseeds and potatoes proved the most profitable of these crops from the fact that in most districts they had previously been grown to some extent. The other crops were being introduced into districts where, up to that time, paddy was practically the only crop grown. The agricultural staff was not sufficiently numerous to give necessary and timely instructions about the selection of lands suited to the various new crops, and about the best methods of seeding and cultivation. The consequence was that the crops did not give as good results as were expected. In spite of some failures to obtain a profitable return, this work has been productive of good results in many ways. For instance many cultivators have been accustomed to the idea of growing a food crop in the cold weather—an operation which they had previously not considered or thought possible. Some idea of the proper methods of cultivation of these crops has been gained,

which should make it easier to increase their cultivation in succeeding years. The agricultural officers have come in contact with many people that they would not otherwise have met and should therefore be in a better position to advise and help them in agricultural matters in future.

As the district is liable to frequent floods with the accompanying risk of destruction of the main food crop—rice, it is desirable that additional or alternative food crops should be tested. Accordingly arrangements are being made to carry out experiments with a number of such food crops in the coming cold weather.

10. In addition to the abovementioned quantity of seed potatoes, a consignment of 3.5 tons of Shillong seed potatoes was sent to Bejora district in Habiganj. This was sold to cultivators in the district at current market prices, viz., Rs. 5 per maund of 80 lbs. The crop proved highly successful and as a result there is a demand for a very much greater quantity in the coming cold weather.

11. From time to time a number of European and Indian gentlemen who are interested in agriculture have been appointed Honorary Correspondents of the Agricultural Department. The majority of these gentlemen find that they have perhaps little time or opportunity for carrying out experiments, or for encouraging the cultivators in their neighbourhood to give the recommendations of our officers a trial. A few, however, maintain their enthusiasm and give very considerable help to our work in many ways. Among these may be mentioned Babu Joynath Nandy of Bejora who has steadily encouraged the cultivation of potatoes in his district for several years, and through whose exertions the demand for seed potatoes from that district has now risen to many hundred maunds. Babu Pavitra Nath Das of Beanibazar has carried out many experiments on his own lands and encouraged his cultivators to adopt our recommendations. Messrs. D. Feigerson, Dhamai and J. Lawrie, Akbarpur have assisted us frequently by supplying fruit plants to people desirous of growing them in the province and occasionally to people from outside the province.

SHILLONG :

The 14th September 1917.

J. W. McKAY,

Deputy Director of Agriculture,
Surma Valley, Assam.

GLOSSARY.

Kharif	...	...	...	The rainy season.
Rabi	...	...	...	The cold season.
Ratoon	...	...	...	The second year's sugarcane crop grown from plants put down in the previous year.
Aus	...	...	...	Autumn rice.
Sail	...	...	...	Winter rice.
Asta	...	...	...	A short-stemmed variety of deep water winter rice.
Dhaincha	...	...	...	<i>Sesbania aculeata</i> .
Cowpea	...	...	...	<i>Vigna catianga</i> .
Jowar	...	...	...	<i>Andropogon sorghum</i> var. <i>vulgare</i>
Kalai	...	...	...	<i>Phaseolus mung</i> var. <i>radiatus</i> .
Khesari	...	...	...	<i>Lathyrus sativus</i> .
Musur	...	...	...	<i>Lens esculenta</i> .
Mung	...	...	...	<i>Phaseolus mungo</i> .
Gram	...	...	...	<i>Cicer arietinum</i> .
Coriander	...	...	...	<i>Coriandrum sativum</i> .
Radish	...	...	...	<i>Raphanus sativus</i> .
Rape	...	...	...	<i>Brassica Campestris</i> .
Matikalai	...	...	...	<i>Phaseolus mungo</i> var.
Kulthikalai	...	...	...	<i>Dolichos biflorus</i> .
Lucerne	...	...	...	<i>Medicago sativa</i> .
Wheat	...	...	...	<i>Triticum vulgare</i> .
Oats	...	...	...	<i>Avena Sativa</i> .
Sugarcane	...	...	...	<i>Saccharum officinarum</i> .
Beer seen	...	...	...	<i>Trifolium alexandrinum</i> .
Soy beans	...	...	...	<i>Glycine hispida</i> .
Paddy	...	...	...	<i>Oriza sativa</i> .
Indigo	...	...	...	<i>Indigofera</i> <i>aria</i> .
Groundnuts	...	...	...	<i>Arachis hypogaea</i> .
Sunn Hemp	...	...	...	<i>Crotalaria juncea</i> .
Job's tears	...	...	...	<i>Coir lachryma</i> .
Raishan	...	...	...	<i>Paspalum sanguinale</i> .
Maund	...	...	...	82½ pounds.
Jhum	...	...	...	A system of cultivation consisting of paving and burning the surface.